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A NEW STAR IN A STAR CLOUD.

BY RICHARD A. PROCTOR.

THE discovery of a new star in the midst of the Great Nebula in Andromeda must be regarded as one of the most remarkable astronomical events of the age. It is true that great changes have ere now been recognised in stars lying within nebulous clouds. The star Eta Argûs for example, which lies in the midst of that wonderful mass of luminous gas called the Keyhole Nebula in Argo, has changed so marvellously in lustre since it was first catalogued as a fourth magnitude star as to present a case corresponding so far as the star is concerned with the sudden appearance of the new star in the Andromeda Nebula. For Eta Argûs sank from the fourth magnitude to the sixth, then rose rapidly to the second, and after remaining for some time at that magnitude increased almost suddenly in splendour until it rivalled Canopus and was surpassed only by Sirius. Undoubtedly to an observer set at such a distance that Eta Argûs when thus resplendent would have appeared only as an eighth magnitude star, like the new star in Andromeda, Eta with its present light of a sixth magnitude star would be altogether invisible. So that viewed from that imagined distance Eta Argûs when it rose to its greatest splendour would have appeared as a new star, and as it faded out of view would come to be regarded as having been but a temporary star.

Again the star which appeared in Cygnus in 1876 must be regarded as a star which had suddenly shone out in a nebula, although no nebula had been known where the star appeared. For when that star had disappeared there still remained a blue planetary nebula in the place which the star had occupied. And this nebula was and is so faint that one can readily understand it having escaped notice before No one, I imagine, can doubt that the nebula which is seen there now existed there before the star appeared.

The stars in the great Fish-mouth Nebula in Orion exhibit also a certain degree of variability, which, though not so striking as the appearance of "new stars," is in reality a phenomenon of the same sort. For every so-called "new star" may be regarded as a variable of an unusually irregular kind.

But in all these cases the star which shone with variable lustre, or which for a time appeared as a new star, has been in the midst of a gaseous nebula. The great nebula in Andromeda has always been regarded as a stellar nebula, although it has never been resolved into stars. Under spectroscopic examination it presents the rainbow-tinted streak crossed by absorption lines which indicates the existence of glowing solid or liquid or highly-compressed vaporous matter shining through absorptive vapours. I remember Dr. Huggins describing the spectrum of this object to me, during a visit which I paid to his observatory in 1866; and he then said that the spectrum differed only from that of a star, in being rather sharply cut off at the red end, as if through the action of vaporous envelopes more powerfully absorptive of red light than the vapours around our sun and most other stars.

In a rather carelessly-written paragraph in the *Times* of Saturday last, manifestly by a person not well acquainted with astronomical facts, the new star is spoken of as if it gave support to Laplace's nebular theory. In reality the appearance of the star is most strongly opposed to that theory, for the simple reason that all the processes involved in Laplace's nebular theory are slowly-acting ones, while the appearance of a new star where a star had not before been visible, signifies events of a catastrophic nature. Moreover the theory of Laplace, in the form in which it was presented, cannot be maintained by any one acquainted with the laws of physics. A vast disc of gaseous matter, extending beyond the orbit of Neptune, but containing no more matter than there is in the whole solar system would not have the slightest cohesion among its various parts. To conceive of it as rotating like a single mass is to imagine the impossible. One may say indeed of Laplace's nebular hypothesis—which was very properly regarded by himself as but a guess—that astronomers suppose it physically possible and physicists suppose it astronomically possible: but no one who combines a knowledge of both astronomy and physics can accept it in the wide generality of its original form.

What the new star really does throw light upon, and light of a very clear and unmistakable sort, is not the theory of the solar system, but the theory of the stellar system—that grand gathering of stars, star-clusters, star-clouds, and star-streams, which we call the galaxy.

If there was one member of the family of nebulæ which was still supposed to remain possibly an external galaxy, after all the evidence which had been collected to show that nebulæ belong to our own galaxy, it was the great nebula in Andromeda,—the transcendently beautiful queen of the nebulæ as the old astronomers enthusiastically called it. Mr. Herbert Spencer observed as far back as 1859 or 1860, in his fine essays on the Nebular Hypothesis in the *Westminster Review*, that the theory according to which numbers of the resolvable nebulæ are external star systems is absolutely untenable. He pointed to this fatal objection, that Sir William Herschel's most powerful telescopes failed to resolve the remoter portions even of our own galaxy. How then could they—or indeed in many cases much weaker telescopes—by any possibility resolve galaxies lying far beyond its limits. A resolvable nebula which has an apparent greatest diameter of a quarter of a degree of arc, would be a very large one indeed; yet even one of that apparent size must lie at a distance exceeding its own diameter about 230 times, and exceeding

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therefore (supposing that nebula a galaxy like our own in size) the distance of the outskirts of our galaxy from us, more than 450 times. This would correspond to a diminution in the lustre of individual stars more than 200,000 times. Now Herschel had to withdraw from the survey of the remotest parts of our galaxy, or at any rate the least resolvable parts (for my own interpretation of their irresolvability does not assume great distance as a necessary point), satisfied, as he said, that those depths are unfathomable. Irresolvable nebulosity foiled his most powerful telescopes, within the limits of our own stellar domain. How preposterous then, when considered a little, the belief that the same telescope which failed to resolve the outskirts of our own galaxy, can bring into view individual stars having less than the 200,000th part of the light of those remoter suns of our stellar system.

Mr. Herbert Spencer pointed out another fatal objection, in Sir W. Herschel's own account of the arrangement of the stellar and nebular groupings. For Herschel said that whenever he found his star gauges running poor, he would call out to his elder sister, Miss Caroline Herschel, who acted as his assistant, "Prepare to write, nebulæ are about to appear." This peculiarity of arrangement by which nebulæ fit in where stars are sparsely strewn, and *vice versâ*, must be regarded as proof positive of the association between nebulæ and stars. Nebulæ must belong then to our galaxy.

I myself collected some forty pieces of evidence as to the structure of our galaxy, by which as I believe the old-fashioned theory (in favour of which not a single direct argument has ever been adduced) was shown to be absolutely untenable. I may remark in passing that I propose to publish in the first monthly number of the new series of KNOWLEDGE a letter which I addressed to Sir John Herschel in 1870, wherein the greater number of the arguments on which the objections to the old theory are based were briefly indicated. In the second number of that series I propose to publish his singularly interesting reply to that communication. I feel that the time has come to make known precisely how that great astronomer viewed the questionings then being addressed to the theory with which—not quite correctly—his own name and his father's have been associated.

But while Mr. Spencer's objections (of themselves) sufficed to demonstrate the utterly untenable nature of the theory of galaxies of stars external to our own stellar system; and my own more laboured gathering of evidence on the subject should have left no doubt, even in the minds of those last ready to recognise the force of reasoning in such matters, the great nebula in Andromeda was in some degree outside our evidence.

The Andromeda nebula is not gaseous but manifestly stellar; yet it has not been resolved into stars. Nor had it been possible to show how far the nebula was from resolvability. Some, using very powerful telescopes on the nebula supposed they had come very near to resolving it into discrete stars; but they could not feel sure on such a point. For anything yet shown, telescopes a thousand times more powerful than the great Rosse telescope (imagined for the moment as perfect in defining power) might have failed to resolve the Andromeda nebula into stars.

Therefore Mr. Herbert Spencer's first objection, fatal against all resolved or partly-resolvable nebulæ, had no *fatal* force (it had considerable force however) against the Andromeda nebula. Of course the other objection had no force at all if this nebula is once regarded as exceptional. Among all my own objections against the theory of external galaxies, few had much force against the Queen of the Nebulæ, and certainly none were absolutely decisive against this great agglomeration of unquestionably stellar material being an external galaxy.

Now, however, it need hardly be said, the question is disposed of. A star-cloud cannot possibly be an external galaxy resembling our sun if there can appear in it suddenly a star where no star had before been seen. Were the Andromeda nebula such a galaxy the change which has recently taken place in it (or to speak more precisely, the change of which the light-brought news has recently reached us) would correspond to such a change in our galaxy as would alter its whole character. A star millions of times larger than any orb in our galaxy would have to be present in it—to begin with—and then after being so dull as to give no more light than an ordinary sun—would have to blaze out suddenly with hundreds of thousands of times as much light even as the splendid Sirius pours forth, to produce such a change of aspect in our galaxy, supposed to be seen from the distance of the Andromeda nebula, as has actually taken place in that star-cloud.

The theory that the star-clouds, or any of them, are external galaxies has received a death-blow. This is not saying it was not dead before. The blow may be such a one as Falstaff gave the dead Percy: but no one can mistake its force. With this new wound the theory has no longer even the semblance of life, and will possibly disappear ere long from those cemeteries for defunct theories, the text-books!

SELF-INHUMATION.

A CONTRIBUTION TO HUMAN HIBERNATION.

By Dr. W. Curran.

STORIES appear every now and then in the papers about priests and other holy members of the Hindu or Mahommedan religions burying themselves alive, for penitential or spectacular purposes, in India. That many of these are exaggerated—*crescunt eundo*—while others are as undoubtedly true, goes without saying, and the *rationale* of all is so little understood in these colder latitudes that it may be as well to say a word or two, by way of introduction to what follows, about it. These practices would, indeed, be otherwise unintelligible, so *outré* or impracticable do they appear, and the atmosphere of India, charged as it is with miracle and fable, is peculiarly suited for displays of this kind. Vicarious suffering or expiation has, moreover, been ever a favourite mode of currying favour with the Deity in that country. Pilgrimages and offerings of all kinds are just as acceptable at the shrines of Allah and Budh as they are at those of Vishnu and Siva, and self-destruction, for an incurable malady or other deprivation or calamity, is expressly sanctioned in one of the holiest of the Hindu Shastres.*

"The invasion of the Punjab by Alexander in B.C. 327

* "The Bramah Pooranee expressly directs as follows," says Ward in his view of the History, Literature, and Religion of Hindoos, p. 125:—"Let the man who is afflicted with a grievous and incurable disease enter a burning fire, or procure his death by starvation, or by plunging into unfathomable waters, or by precipitating himself from an eminence, or by ascending to Paradise by a respectful pilgrimage to the Himalayan mountains. Whoever relinquishes life or destroys himself (under these circumstances), that high-minded person shall receive a great reward in a future state, and shall not be considered a suicide. Even although he may have been a great sinner, he shall meet with supreme bliss in Paradise."

is," says Mr. Talboys Wheeler,* "the first event which brings India into historical relations with the outer world," and one of the most interesting episodes of this relationship was Alexander's friendship for the Brahmin, Kalanos. This holy man became so attached to his great master that, having probably through this attachment broken his caste obligations or incurred the displeasure of his bigoted associates, he volunteered to accompany him on his return to Greece. But he never reached his destination, for finding the burthen of age or of travel too much for him, or being rather oppressed by some painful disorder, he sought, and obtained, permission to take away his own life. Arrian assures us that, accompanied by his friends, he deliberately mounted a funeral-pyre that was erected in sight of the army and, setting fire to this with his own hands, he perished in the flames. Grant Duff † ascribes a similar disregard of death or dread of suffering to his friends the Mahrattas, and General Sleeman ‡ knew—circiter annis 1828-30—"a wealthy Hindu gentleman who came a distance of two hundred miles or more to the banks of the Nerbudda for the express purpose of drowning himself in that sacred stream. He was accompanied by a large retinue of friends and relatives, of whom, after the usual ceremonial observances of his caste and creed, he took an affectionate farewell. He then entered the boat that took him into the deepest part of the river, and having loaded his body with sand, as a sportsman who is required to carry weights in a race loads himself with shot, he slipped into the water and disappeared."

"Many poor men," he adds, "do the same every year when afflicted by any disease that they consider incurable," and the so-called "Ghât-murders" of the Ganges and the Hooghly are relics of the same tradition and spirit. So also were Suttee, the swinging from hooks through the loins, the tongue-piercings, the live-burials, and other horrible tortures of that kind that were formerly so common in that country. The friends or relatives of the doomed devotee, being unable to afford him the luxury of a boat to carry him into deep water, placed him on the margin of the river, and having stuffed his mouth with mud in the usual orthodox fashion, left him to die as best he may. And so determined on self-destruction were these infatuated victims of superstition, that they bitterly resented any attempts that might be made by outsiders for their rescue. Nay, even they subsequently reproached § their deliverers with having been the cause of their disgrace in this world and ruin in the next; and I believe myself that were we to withdraw from India to-morrow, all these frightful practices would be revived again there.

I am glad to find this, my opinion, confirmed by so competent a witness as Mr. James Fergusson, D.C.L., &c. Discussing the relationship of some of these practices to the monoliths, &c., he is describing, he says ("Rude Stone Monuments," p. 38) that "even now, with all our colonisation and civilising power, we have had marvellously little real influence on the native races (of India), and were our power removed, all traces (of our rule) would rapidly disappear, and the people would revert at once to what they were, and act as they were wont to do before they knew us" at all. He acknowledges further, on p. 459, that "the Bliêl, the Cole, the Gond, the Todd, and other tribes remain as they were, and practise their own rites and follow the customs of their forefathers as if the stranger had never come amongst them," and he adds (p. 461) that "if our strong repressive hand were once removed, it cannot be doubted but that the human sacrifices—previously referred to—would be instantly resumed." So would suttee, female infanticide, ghât-murders, and self-inhumations, for the spirit that underlies the whole fabric and framework of what is—derisively or facetiously—called Indian civilisation, *alias* superstition glossed over, not buried, is not dead but sleepeth; and the same may be said of other primitive or semi-civilised tribes and races, *tantum (potest) religio suadere malorum*.

With regard to the phenomena set forth in the stories here referred to, I may be permitted to say *in limine* that I inquired into them on the spot, with this result, that the few Europeans who had heard of them disbelieved them; while, as regards the natives they were, as might be expected from their surroundings, &c., divided on the point. The Mahomedans, influenced as they inevitably must be, by the extraordinary ecstatic feats * of their own holy men, did not actually regard such a disposition of the body as this kind of interment implies as necessarily incompatible with its vitality. They were staggered, however, when confronted with the facts of the case as these were translated by me for them, and all I could get from several of them was a, "Shaiud Sahib, perhaps so, sir, there is no knowing." There is, indeed, no knowing, and as to the Hindus they all accepted these narratives without hesitation or demur. But then the mythology of the Hindus is wilder and madder than that of Olympus, and thousands, millions amongst them believe that when the mystic union of the Yogi of the period is effected with Sivâ, he "can make himself lighter than the lightest substance, heavier than the heaviest; can become as vast or minute as he pleases; can traverse all space, animate any dead body by transferring his own spirit into it; and, finally, can become acquainted with the past, the present, and the future." † What a treasure such a Yogi would be, to be sure, in a London newspaper office in the dull season, and what a pity it is he cannot be imported for this purpose, or manufactured to order on the premises. But the Kala Pānee (black-water) interposes its baneful presence, and were one of these odorous worthies to spread his carpet in Shoe-lane or Belle-Sauvage-yard, the local inspector of nuisances would interfere, if, indeed, he had not been already forestalled by the local policeman.

(To be continued.)

* "The History of India, from the Earliest Ages," Vol. ii., p. 172.

† "The History of the Mahrattas," Vol. i., p. 424.

‡ "The Rambles and Recollections of a Bengal Officer," Vol. i., p. 345.

§ Ward has a curious illustration in point. The rescued man used to reproach and curse his deliverer whenever he met him. Nor was he much to blame for this, for he was an outcast, and, as Mr. Fairholt truly says ("Up the Nile," p. 294): "The undying character of popular superstition is more certain than the stability of a religious faith." "Nothing is so difficult to kill as an old superstition; the more unreasonable it is, the harder," says Mr. Fergusson ("Tree and Serpent Worship," p. 70), "it dies."

THE *Engineer* observes that the South-Eastern Railway supremacy in unpunctuality provided its chairman a few days ago with the pleasure of about an hour's waiting for his destination near Dover.

* Describing the performances in this line of a Mahomedan priest in the Gadûn country, near Peshâwur, Mr. Hughes says ("Notes on Muhammadanism," p. 152) that "he has become such an adept in the performance of the *zarb*—a most exhausting devotional act—that he recites the first part of the zikr (prayer) with the exhalation of his breath, after the mid-day prayer, and the second part with the inhalation of his breath before the next time of prayer, thus sustaining his breath for the period of about three hours."

† "Travels in Kashmir, &c." By J. T. Vigne, pp. 307-8.

OUR DUAL BRAIN.

By Richard A. Proctor.

In a recent lecture at the Royal Institution, Mr. Horsley offered evidence (which seems to me not very strong) against the theory of the duality of the mind. A person who, being already fairly well able to draw with either hand separately, attempts to draw simultaneously two different forms, however simple, with both hands, is tolerably sure to fail. Mr. Horsley appears to think that failure always results. When the effort is made, he says, "There is a very definite sensation in the mind of a conflict that is going on in the cortex of the brain. The idea of the circle alternates with that of the triangle, and the result of this confusion in the intellectual and sensorial portions of the brain is that both motor areas, though remembering, as it were, the determination of the experimenter to draw distinct figures, produce a like confused effect, namely, a circular triangle and a triangular circle."

Mr. Horsley adds that if the drawing is commenced immediately at the sound of a signal (as should always be done in such experiments), it will be found that the triangle predominates, while, on the other hand, if the two figures are not commenced simultaneously, the one last begun will appear most distinctly in the fused result, in fact, will very markedly predominate. He reasons upon this as follows:—"The idea of a triangle and circle having been presented to the intellect of the sensory centres, the voluntary effort to reproduce them is determined upon: now if we had a dual mind, and if each hemisphere was capable of acting *per se*, then we should have each intellectual area sending a message to its own motor area, with the result that the two figures would be *distinct and correct*, not fused."

To this experimental evidence and to its interpretation two distinct answers can be given. In the first place, it does not always happen that the attempt to draw two different objects simultaneously fails in the alleged manner. Setting on one side as probably exaggerated the story that Sir Edmund Landseer drew on one occasion a deer's head with one hand, while he was drawing a landscape with the other, I may cite from my own experience a case which entirely invalidates Mr. Horsley's evidence. My friend, Professor Edwin Morse, of Salem, Mass., could draw simultaneously, and that, too, before an audience, two different objects with either hand. Or he would draw an object with one hand, and at the same time write the names of the parts of the object with the other. With practice much skill may be acquired in this ambidextrous work.

Here is a simple experiment to show the effect of practice. Try for the first time to write a word of so many letters while you spell aloud, letter by letter, another word containing the same number of letters. At first you are almost sure (perhaps quite sure) to fail. But after a few trials what had seemed impossible becomes feasible, and presently it becomes quite easy.

Then, even if it were proved that we cannot do two different things at once (apart from cases where either or both is done automatically), this would no more prove that the brain is not dual than our inability to use the two eyes simultaneously to do different work would prove that we have not dual vision.

As a matter of fact we are able to prove very easily that vision is double, by alternately closing and opening either eye. We cannot make any corresponding experiment with the brain. We do not know even that, when we are trying to do simultaneously two different things the two different sides of the brain are called into action. We have positively no means of determining whether one side, or the other side, or both sides of the brain shall be used, or of knowing whether they are used. Even in those cases where marked alternations of character, accompanied or preceded by marked cerebral phenomena, show unmistakably that two different parts of the brain may alternate in the regulation of actions and even of character, the person thus dually minded and charactered is perfectly powerless as to the particular mental side of him which shall come uppermost (or act alone). He often does not even know that he is passing or has passed from one state to the other.

Since, however, we are absolutely certain that each eye does its work, while we are absolutely unable to make them work separately yet simultaneously—to make one eye work at long range, for example, and the other at short range, the argument used by Mr. Horsley in regard to the brain is altogether without force.

If any one could make his two eyes work separately, I should be the one to do it, for my left eye is permanently limited to work at short focal distances, while the right eye has the usual range. Yet, not only am I powerless to make my two eyes work separately and simultaneously, but I am very seldom conscious of the fact that the left eye is in reality presenting to the brain (so to speak) a very different picture from that which is presented by the right eye.

I remained unconscious of the difference between the focal lengths of my two eyes, marked though it is (insomuch, that for ordinary distances my left eye is almost blind), till I was about twenty; at least I know it must have been more than twenty-six years ago that I detected the peculiarity. I was in church one Sunday evening, listening or not listening to a rather dreary sermon, in which a person whom I had reason for regarding little was enjoining duties which I had long learned to regard a great deal; and being naturally inattentive to him, I attended to other things. Now, there were in front of me two bright lights, and I noticed to the right of them two blurred lights, looking as large as the moon, where assuredly no lights were. I looked at another group of lights, three of them—and lo, to the right of them also, a group of three, similarly arranged, blurred lights. I closed my left eye, and could see only the bright lights; I closed my right eye, and could see only the blurred lights. That was all my left eye could do in the way of showing those lights.

Thus, for the first time in my life, I learned that so far as distant objects were concerned I was almost blind of one eye. But I soon found that my left eye was by no means blind for near objects; on the contrary, it was and is very keen for them. Yet I cannot make my eyes, different though they thus are, work separately, except in an imperfect sort of way, akin to the way in which, in Mr. Horsley's experiment, one hand makes a circular triangle while the other makes a triangular circle. I am well assured my vision is double, as all men are; nay, in my case vision is even of two kinds with the two eyes: yet I have precisely the sort of evidence respecting my two eyes which Mr. Horsley regards as evidence of unity.

Mr. Horsley cites a singular illustration of the duality of the mind, of which, however, he endeavours to dispose. The case is so remarkable, and, just now when all sorts of foolish superstitions are as rife as ever, so instructive, that I give its details here pretty nearly in full, as recorded by Prof. Ball, of Paris. He tells us that a

young man, a patient of his, one morning heard himself addressed by name, and yet could see no one. He replied to this invisible, and in reality imaginary, interlocutor; and a conversation followed, in the course of which the ghostly visitor informed him that he—the visitor—rejoiced in the name of Gabbage. After this, he was often favoured with visits from M. Gabbage. Unfortunately, the suggestions of M. Gabbage were generally open to objection. At one time M. Gabbage urged the patient to give an overdose of chlorodyne to a friend's child, at another his idea was that the young man would do well to jump out of a second-floor window.

Prof. Ball thought—naturally enough—that the young man needed watching. It was presently found that the patient was suffering from one-sided hallucination; that is to say, a strong but false impression, affecting one side only of the brain, appeared to come from some external cause, the healthy side rejecting the evidence as false. (Without doubt many superstitions, many false religious beliefs, and also many crimes, have been suggested in this way.)

Mr. Horsley finds nothing in this or similar cases to suggest the duality of the brain; but I take it that the evidence is precisely analogous to that which showed me not only the duality but the diversity of my own visual powers. Usually, of course, the two sides of the brain would give the same sort of evidence respecting external objects; just as—usually—the two eyes do: but in certain cases one side of the brain is defective or peculiar in some way or other, and so gives evidence which the better and sounder side rejects; just as in my case one eye gave evidence of large diffuse lights where I knew, from the sound evidence of my better eye, that small bright flames were burning. The analogy seems as perfect as it can be; and the necessary conclusion is that the brain's action, in ordinary cases, is as essentially dual as the action of the eyes in vision.

MYSTERIES AND MORALITIES.

By EDWARD CLODD.

VI.

WHATEVER afforded material for more vivid presentment of incidents connected with the birth of Christ was gladly utilised by the dramatisers, and in the meagreness of the canonical narratives, as well as in their silence, the Apocryphal Gospels, with their freer treatment of the mysteries of the miraculous conception and their record of the scandal to which it was assumed to give rise, were largely drawn upon.

This is especially noticeable in the Coventry series, in which eight plays bearing upon events preceding and surrounding the Nativity are based upon the Protevangelium or Gospel of James, the Gospel of Mary, and the History of Joseph the Carpenter. They treat of the barrenness of Anna, of Mary in the Temple, of her betrothment, of the salutation and conception, of Joseph's jealousy, of the visit to Elizabeth, and of the trial of Joseph and Mary.

Joseph's Jealousy, or Trouble about Mary, is the subject of a play in each series, the Chester excepted, in which the treatment of all incidents surrounding the birth of Christ is meagre. Joseph, when "very far advanced in years," had, as one of the house of David, been cited with his kinsmen to appear before the "Busshop" with "whyte yardys" in hand, that on whatsoever man's rod the "Holy Gost is syttynge," he should be betrothed to Mary. Joseph, who says:—

> I have be maydon evyr, and evyr more wele ben,
> I chaungyd not yet of alle my long lyff;
> And now to be maryed sum man wold wen (guess),
> It is a straunge thynge an old man to take a yonge wyff,

is appalled when, despite his striving to keep in the background, the "ded stok beryth floures," and he is told that he must take Mary to wife.

> Nay, nay, sere, lett bene,
> Xuld I now in age begynne to dote,
> If I here chyde she wolde clowte my cote,
> Blere myn ey, and pyke out a mote,
> And thus oftyn tymes it is senc.

But when told that God has ordained it he assents, and the betrothal follows, Joseph "hiring a lytyl praty hous" for Mary, where he leaves her to the care of five maidens while he travels to a "fere countré"—

> For in sothe we have non hous of oure owe,
> Therfore I xal gon ordeyn and thanne come yow fore."

The course of events is broken in the Coventry series by a pageant of the *Parliament of Heaven*, or, as Hone calls it, *A Council of the Trinity*, opening with a prologue by Contemplacio, who recites the fall of man and his need of redemption. Veritas, Justitia, and Misericordia alike supplicate the Divine mercy, and as the result of a council between the persons in the Trinity, the angel Gabriel is commanded to visit Mary and announce to her that "the son of the Godhead of here xal be bore." He salutes her with an anagrammatic pun if the reading "av ye" instead of "ar ye" is correct:

> Heyl, fful of grace, God is with the,
> Amonge alle women blyssyd art thu;
> Here this name Eva is turnyd Ave,
> That is to say withoutte sorwe av ye now.

A little after this the following stage direction occurs:

Here the Holy Gost discendit with iij. bemys to our Lady, the sone of the Godhed vest with iij. bemys to the Holy Gost, the fadyr Godly with iij. bemys to the sone, and so entre alle thre to her bosom, and Mary seyth:—

> *Maria.* Ah! now I ffele in my body be
> Parfyte God and parfyte man,
> Havyng alle schappe of chyldly carnalyté,
> Evyn al at onys thus God began.*

At the end of nine months Joseph returns, and finding Mary pregnant, rues the evil day when he was forced to wed, then meets her with reproaches for her faithlessness and with questions as to who has thus wronged him.†

He will not believe the strange answer which she gives him, and will steal away and leave her, but that an

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* *Coventry Mysteries*, pp. 114, 115.

† *York Mysteries*, p. 105:—
> Whose is't, Marie?
> *Mar.* Sir, Goddis and youres.

Towneley Mysteries, p. 76:—
> Who owe this child thou gose with alle?
> *Maria.* Syr, ye and God of Heven.

Coventry Mysteries, p. 118:—
> Ow! dame, what thinge menyth this?
> With childe thou gynnest ryth gret to gone.
> Sey me, Mary, this childys fadyr ho is!
> I pray the telle me, and that anon.
> *Maria.* The fadyr of hevyn and ye it is,
> Other fadyr hath he non;
> I dede nevyr forfete with man i-wys;
> Wherfore I pray you amende your mon,—
> This childe is goddys and your.

angel appears and convinces him of her innocence and purity:—

She has consayued the Holy Gos',
And she shalle bere Godes son.*

The *rapprochement* between the two, when Mary forgives the repenting Joseph for doubting her, is represented with much tenderness:—

Saie, Mary wiffe, how fares thou?
Mar. The bettir sir for yhou,
Why stand yhe thare? Come nere.
Jos. My bakke fayne wolde I bowe
And aske fo[r]gifnesse nowe,
Wiste I thou wolde me here.
Mar. Forgiffnesse, sir! late be! for shame,
Slike (such) wordis suld all gud women lakke.†

The Towneley play corresponds to this too closely to need quotation; but in the Coventry there is a pretty touch when, in response to Joseph's desire to kiss Mary's "swete fete," she says:—

Nay, lett be my fete, not tho (those) ye take,
My mouthe ye may kys i-wys,
And welcome onto me.

A distinctive pageant of this series, based on the *Trial of Joseph and Mary*,‡ is ushered in by an amusing address citing the persons named to appear before the Buschop:—

Bothe John Jurdon, and Geffrey Gyle,
Malkyn Mylkedoke, and fayr Mabyle,
Stevyn Sturdy, and Jak at the Style,
And Sawdyr Sadelere.

Thom Tynkere and Betrys Belle,
Peyrs Potter and Whatt at the Welle,
Symme Smalfeyth and Kate Kelle,
And Bertylmew the Bochere.
Kytt Cakelere and Colett Crane,
Gylle Fetyse and fayr Jane,
Powle Pewterere and Pernel Prane,
And Phelypp the good Flecchere.

Cok Crane and Davy Drydust,
Luce Lyere and Letyce Lytyltrust,
Miles the Myllere and Colle Crakecrust,
Bothe Bette the Bakere, and Robyn Rede.

And, adds the officer, showing that money was collected at the performances:—

And loke ye ryngewele in your purs,
Ffor ellys your cawse may spede the wurs,
Thow that ye slynge Goddys curs
Evyn at myn hede, ffast com away.

Bothe Boutyng the Browstere, and Sybyly Slynge,
Megge Merywedyr and Sabyn Sprynge,
Tyffany Twynkelere, ffayle ffor nothynge,
The courte xal be this day.§

* *York Mysteries*, pp. 110, 111:—
Gabriel. The childe that sall be borne of her,
Itt is consayued of the haly gast,
Alle joie and blisse than sall be aftir,
And to al mankynde nowe althir mast (all that is best).
Jesus his name thou calle,
For slike happe sall hym fall
Als thou sall se in haste.
His pepull saff he sall
Of euyllis and angris all
That thei ar nowe enbraste.
Coventry Mysteries, p. 121:—
Angelus. Sche is a ful clene may.
I telle the, God wyl of here be born,
And sche clene mayd as she was beforn,
To save mankynd that is forlorn,
Go chere hyre therfore, I say.

† *York Mysteries*, p. 111.

‡ *The Gospel of Pseudo-Matthew*, ch. xii (Cowper's ed.), pp. 46-49.

§ *Coventry Mysteries*, pp. 131, 132.

The charge of unchastity against Joseph, and more especially against Mary, is brought by two slanderers in language of unvarnished plainness, when the Bishop interrupts them and sends for the accused, who deny the charge, and are then severally bidden to submit their innocence or guilt to the test of ordeal by drinking the "botel of God's vengeannes,"* which would prove them guilty by producing "sum maculacion pleyn on the face."

Joseph drinks, walks round the altar seven times, and establishes his innocence; then when Mary offers to do the like, *Primus detractor* says jeeringly:—

In ffeyth I suppose that this woman slepte
Withowtyn alle coverte, whylle that it dede snowe,
And a flake thereof into hyre mouthe crepte,
And thereof the chylde in hyre wombe doth growe.†

And *Secundus detractor*, following up the sneer, says:—

Than beware dame, for this is wel i-knowe
Whan it is born, yf that the sunne shyne,
It will turne to watyr ageyn, as I trowe,
Ffor snow onto water dothe evyr more reclyne."

Mary passes through the ordeal without "maculacion," and when the Bishop declares her "clene mayde, both modyr and wyff," *Primus detractor* charges him with having changed the draught, whereupon the slanderer is compelled to swallow what is left of it, and his sickness thereat is assuaged only through the Virgin's prayer.

RAMBLES WITH A HAMMER.

By W. Jerome Harrison, F.G.S.

HUNSTANTON AND THE RED CHALK.

OUR rambles have hitherto been confined to Wales and to the Midlands. It is now time to give the East coast a turn. The strata which form our little isle slant or "dip" to the east, the older beds passing under the newer in that direction. The result of this arrangement is that the oldest rocks form the surface of Wales, while the newest, latest-formed beds, occupy the shore-line round the mouth of the Thames.

In considering the rocks of any district we must always bear in mind the difference between its *solid* and its *superficial* geology. On an ordinary geological map only the former is shown, the stripes of colour indicating the various rocks which there form distinct beds or strata, such as can be followed in layers deep down into the earth. But these, so-called, solid rocks are frequently covered over and concealed by "superficial" beds of clay, sand, &c., often of great thickness, left by the melting of the glaciers or icebergs which invaded England during the last glacial period, perhaps some quarter of a million years ago. In the Eastern counties it is especially necessary to bear this distinction between the "solid" and "superficial" strata in mind, for nowhere else are the latter so well developed. An incipient geologist—say a farmer who is trying to learn something about the soil of his farm—may well be astonished when his geological map shows him the surface of Norfolk as a nearly uniform mass of white chalk; while his experience in digging, well-sinking, &c., tells him of thick beds of clay and sand occupying the same area!

* Cf. Numbers, v. 10-31. The Bitter Water was one of several ordeals in use among the Hebrews, and bears an analogy to the poison ordeals of Africa and the East; it was abandoned by R. Johanan ben Saccai about the time of the Christian era.

† *Coventry Mysteries*, p. 140. The story of a snow-child was popular in the Middle Ages, and a charming variant of it is given in "Naake's Slavonic Fairy Tales," pp. 9-16.

This discrepancy is now being remedied by the publication by the Government Geological Survey of *two* sets of geological maps for each district; the one showing the deep-seated rocks only, while the other—called the "Drift Maps"—show the exact nature of the rock, be it "solid" or "superficial," which *actually forms the surface* at any given point. With this preliminary explanation, we will pass on to the special subject of our paper—the rocks of that rising sea-side resort, Hunstanton.

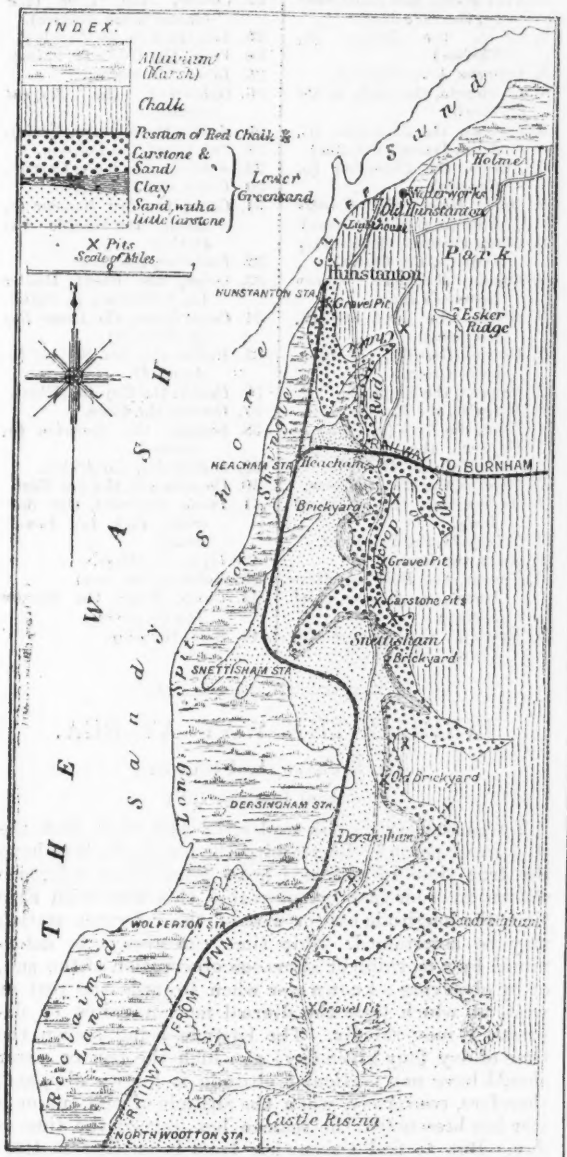


Fig. 1.—Geological Map (without Drift) of the Neighbourhood of Hunstanton (by W. Whitaker).

* The Red Chalk has been traced from Hunstanton southwards, to beyond Snettisham.

Hun'ston, as the native familiarly terms it, lies at the eastern corner of the Wash, facing the North Sea, and is, of course, in the county of Norfolk. It is well supplied with railway accommodation, in connection with the Great Eastern, Great Northern, and Midland Railway systems, and has grown very rapidly during the last few years. There are two villages—Old Hunstanton and Hunstanton St. Edmund's—divided by a line of chalk cliffs, ninety feet in height. Standing on these chalky heights, we can see Boston Stump (*i.e.*, the tower of Boston Church) across the Wash, to the west, while to the north-west extend the Lincolnshire Wolds, formed of the same white rock as that upon which we stand. It is clear that at some time or other the sea has breached the line of chalk hills, and then hollowed out the estuary, called the Wash, in the softer strata which lie below the chalk. To examine these older rocks, we must descend, and walk westward along the shore.

The dark, hard, gritty rocks, tinged yellow or red by a little iron, which crop out in the beach at Hunstanton, and form the base of the cliff, are sandstones belonging to the *Lower Greensand*, a subdivision of the Lower Cretaceous or Neocomian formation of geological text-books. Our map (Fig. 1), which is a reduction of the Geological Survey map, recently prepared by that excellent geologist, Mr. W. Whitaker, F.G.S., shows this *Lower Greensand*, extending southwards past Snettisham to Dersingham, Sandringham, &c. The pits in which the stone is worked round Snettisham should be carefully examined. The upper division of this sandstone has been hardened by an infiltration of water containing oxide of iron, which has acted as a cement to bind the grains of sand together. This hard, sandy rock is called "Carstone"—perhaps from "Quernstone"—since its gritty nature would make it suitable for the old hand-mills or querns once used to grind corn. It rises into picturesque, low, wooded hills between Hunstanton and Sandringham; the presence of a bed of clay just here, between the two divisions of the Greensand is indicated by a vigorous growth of oaks, while firs flourish on the sandy beds above and below. This clay is worked at Heacham brickyard. The "Carstone"—also called "Gingerbread-stone"—is used for building, while the lower, softer sands are shipped for glass-making. The Carstone at the base of Hunstanton cliff contains numerous small pebbles of quartz, &c.; of fossils there are but few, including some rolled *ammonites*. The total thickness of the *Lower Greensand* is not much more than 70 feet at Hunstanton, and if we could pierce through it, we should find it underlain by a dark, tenacious clay—the *Kimmeridge Clay*—which was indeed reached in a deep boring farther east, at Holkham, at a depth of 743 feet.

(To be continued.)

VARIATION OF A NEBULA.

THE following appeared in the *Times* of Saturday last:—

"SIR,—A circular, dated September 1, from Lord Crawford's observatory, Dun Echt, is as follows:—'Professor Kreuger telegraphs from Kiel at midnight, August 31: Variation in Andromeda nebula found by Dr. Hartwig (of Dorpat), starlike nucleus, please look for it.'

"From an examination of this nebula last night with a six-inch refractor, I can confirm his statement that there is a variation, and that of a most wonderful kind, as I had the great advantage of being able to compare the present aspect directly with a photograph I took last year (August 16).

"The centre of this nebula has hitherto always been noted as a bright condensation of the nebulous matter,

looking as one of the old astronomers said, like a candle in a horn lantern, and so it appears in the photograph. Now it appears as an intensely bright point, entirely different in character and very much more brilliant than before.

"About two minutes of arc from this new bright point there is a faint star many magnitudes less bright; this faint star shows on the photograph as bright, though not so large, as the old central condensation. I have no doubt we have here a case of real change taking place, and that astronomers will watch further developments with intense interest. A. A. Common, F.R.S."

"Ealing, Sept. 4.

"Sir,—The sudden appearance of a new star in the heavens is a rare event, which is so full of interest to many of your readers that it deserves to be carefully chronicled.

"On Aug. 31 Dr. Hartwig, of Dorpat, announced the discovery of a variation in the Andromeda nebula presenting the form of a starlike nucleus. Thanks to Lord Crawford's prompt dissemination of such astronomical news by means of the Dun Echt circulars, astronomers were generally informed of the discovery by Sept. 2.

"Last evening (Sept. 3), on examining the Andromeda nebula, the object was found to be conspicuously visible as a star of the eighth or ninth magnitude shining through the densest region of the nebula. It does not at all present the aspect of a nucleus to the nebula, and at present I have not been able to detect any change in the nebula itself. It seems evident, therefore, that the object is one of those enigmatical variable stars, such as were observed to suddenly blaze forth by Tycho Brahe in Cassiopeia, by Kepler in Serpentarius, and more recently in 1866 by the late Mr. Birmingham in Corona.

"Three sets of photometric comparisons with another star were secured. The small star adopted for a standard was one of the eighth magnitude in the Perseus cluster, and was selected because (1) it was about the same altitude as the new star, (2) observations for several years had shown that its light was not appreciably variable, and (3) because estimations of its magnitude are known, and moreover it is to be identified in the exquisite photograph of this cluster by the MM. Henry, at the Paris Observatory.

"Assuming this star as of 8·1 magnitude (it is probably rather higher), then the three sets of photometric measures, made on the principle of limiting apertures, give for the date 1885, September 3, 9 p.m. to 11 p.m.—'Nova Stella,' 8·8 magnitude, three observations; 8·7 magnitude, eight observations; 8·7 magnitude, four observations; mean 8·72 magnitude.

"If your readers will look towards the east between nine and ten o'clock in the evening, and rather high up, they will see a small misty spot of light—that is the Andromeda nebula—and on taking an opera glass they will not fail to detect in the middle of this misty spot a small star, which is the new one just started into visibility. To the spectroscope we must look to learn something of the nature of this remarkable outburst.

"Edward B. Knobel.

"Bocking, near Braintree, Essex, Sept. 4."

The chairman and directors of the Great Western Railway proceeded through the Severn tunnel in a special train on Saturday fast, accompanied by a number of friends. The tunnel is to be formally opened by the Prince of Wales some months hence.

FIRST STAR LESSONS.

By Richard A. Proctor.

THE constellations included in the twenty-four maps of this series are numbered throughout as follows (the names being omitted on the maps, to clear these as far as possible from all that might render the star-grouping less distinct):—

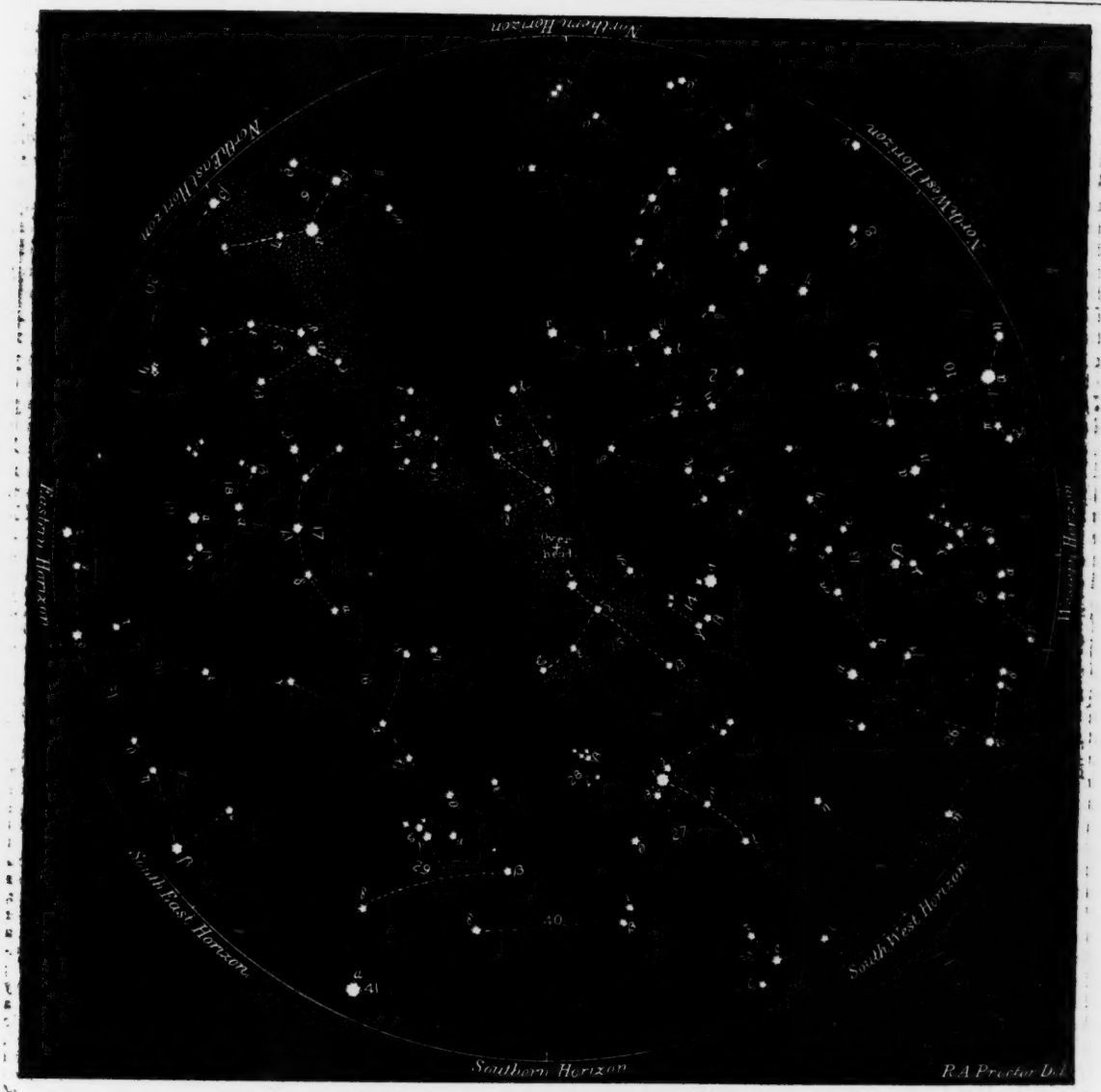
1. *Ursa Minor*, the *Little Bear* (*α*, the *Pole Star*).
2. *Draco*, the *Dragon* (*α*, *Thuban*)
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (*β*, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (*α*, *Capella*)
7. *Ursa Major*, the *Greater Bear* (*α*, *β*, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (*α*, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Boötes*, the *Herdsman* (*α*, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (*α*, *Vega*).
15. *Cygnus*, the *Swan* (*α*, *Arided*; *β*, *Albires*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (*α*, *Aldeburan*; *η*, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (*α*, *Castor*; *β*, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (*α*, *Regulus*).
24. *Virgo*, the *Virgin* (*α*, *Spica*).
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (*α*, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*. the *Fishes*.
31. *Cetus*, the *Sea Monster* (*o*, *Mira*, remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (*α*, *Betelgeux*; *β*, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (*α*, *Procyon*).
35. *Hydra*, the *Sea Serpent* (*α*, *Alphard*).
36. *Crater*, the *Cup* (*α*, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (*α*, *Antares*).
39. *Sagittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (*α*, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (*α*, *Sirius*).
45. *Argo*, the *Ship*.

FINDING THE WAY AT SEA.

By Richard A. Proctor.

(*Continued from page* 194.)

IT will be clear to the reader, by this time, that the great point in determining the longitude, is to have the true time of Greenwich or some other reference station, in order that by comparing this time with ship time, the longitude east or west of the reference station may be ascertained. Ship time can always be determined by a morning or afternoon observation of the sun, or by observing a known star when towards the east or west, at which time the diurnal motion raises or depresses it most rapidly. The latitude being known, the time of day (any given day) at which the sun or a star should have any particular altitude is known also, and, therefore, conversely, when the altitude of the sun or a star has been noted, the seaman has learned the time of day. But to find Greenwich time is another matter; and without Greenwich time, ship time teaches nothing as to the longitude. How is the voyager at sea or in desert places to know the exact time at Greenwich or some other fixed station? We have seen that chronometers are used for this purpose; and chronometers are now made so marvellously perfect in construction that they can be trusted to show true time within a few seconds, under ordinary conditions. But it must not be overlooked that in long voyages a chronometer, however



NIGHT SKY FOR SEPTEMBER (First Map of Pair),

Showing the heavens as they appear at the following hours:—

September 1 at 10¼ o'clock.	Septembcr 9 at 9¾ o'clock.	September 17 at 9¼ o'clock.
September 5 at 10 o'clock.	September 13 at 9½ o'clock.	September 20 at 9 o'clock.

perfect its construction, is more liable to get wrong than at a fixed station. That it is continually tossed and shaken is something, but it is not the chief trial to which it is exposed. The great changes of temperature endured when a ship passes from the temperate latitudes across the torrid zone to the temperate zone again, try a chronometer far more severely than any ordinary form of motion. And then it is to be noted that a very insignificant time-error corresponds to a difference of longitude quite sufficient to occasion a serious error in the ship's estimated position. For this reason and for others, it is desirable to have some means of determining Greenwich time independently of chronometers.

This, in fact, is the famous problem for the solution of which such high rewards were offered and have been given.* It was to solve this problem that Whiston, the same who fondly imagined Newton was afraid of him,† suggested the use of bombs and mortars; for which

* For the invention of the chronometer Harrison (a Yorkshire carpenter and the son of a carpenter) received twenty thousand pounds. This sum had been offered for a marine chronometer which would stand the test of two voyages of assigned length. Harrison laboured fifty years before he succeeded in meeting the required conditions.

† Newton, for excellent reasons, had opposed Whiston's election to the Royal Society. Like most small men, Whiston was eager to secure a distinction which, unless spontaneously offered to him, could have conferred no real honour. Accordingly he was amusingly indignant with Newton for opposing him. "Newton perceived," he wrote, "that I could not do as his other darling friends did, that is,

Hogarth pilloried him in the celebrated madhouse scene of the "Rake's Progress." Of course, Whiston had perceived the essential feature of all methods intended for determining the longitude. Any signal which is *recognisable*, no matter by eye or ear, or in whatsoever way, at both stations, the reference station and the station whose longitude is required, must necessarily suffice to convey the time of one station to the other. The absurdity of Whiston's scheme lay in the implied supposition that any form of ordnance could propel rocket signals far enough to be seen or heard in mid-ocean. Manifestly the only signals available, when telegraphic communication is impossible, are signals in the celestial spaces; for these alone can be discerned simultaneously from widely distant parts of the earth. It has been to such signals, then, that men of science have turned for the required means of determining longitude.

Galileo was the first to point out that the satellites of Jupiter supply a series of signals which might serve to determine the longitude. When one of these bodies is eclipsed in Jupiter's shadow, or passes out of sight behind Jupiter's disc, or reappears from eclipse or occultation, the phenomenon is one which can be seen from a whole hemisphere of the earth's surface. It is as truly a signal as the appearance or disappearance of a light in ordinary night-signalling. If it can be calculated beforehand that one of these events will take place at any given hour of Greenwich time, then, from whatever spot the phenomenon is observed, it is known there that the Greenwich hour is that indicated. Theoretically this is a solution of the famous problem; and Galileo, the discoverer of Jupiter's four satellites, thought he had found the means of determining the longitude with great accuracy. Unfortunately these hopes have not been realised. At sea, indeed, except in the calmest weather, it is impossible to observe the phenomenon of Jupiter's satellites, simply because the telescope cannot be directed steadily upon the planet. But even on land Jupiter's satellites afford but imperfect means of guessing at the longitude. For, at present, their motions have not been thoroughly mastered by astronomers, and though the "Nautical Almanac" gives the estimated epochs for the various phenomena of the four satellites, yet, owing to the imperfection of these tables, these epochs are often found to be appreciably in error. There is yet another difficulty. The satellites are not mere points, but being in reality as large as or larger than our moon, they have discs of appreciable though small dimensions. Accordingly they do not vanish or reappear instantaneously, but gradually, the process lasting in reality several seconds (a longer or shorter time according to the particular satellite considered), and the estimated moment of the phenomenon thus comes to depend on the power of the telescope employed, on the skill or the visual powers of the observer, on the condition of the atmosphere, and so on. Accordingly, very little reliance could be placed on such observations as a means for determining the longitude with any considerable degree of exactness.

No other celestial phenomena present themselves except those depending on the moon's motions.* All the planets, as well as the sun and moon, traverse at various rates and in different paths the sphere of the fixed stars. But the moon alone moves with sufficient rapidity to act as a time-indicator for terrestrial voyagers. It is hardly necessary to explain why rapidity of motion is important; but the following illustration may be given for the purpose. The hour-hand of a clock does in reality indicate the minute as well as the hour; yet owing to the slowness of its motion we regard the hour-hand as an unsatisfactory time-indicator, and only consider it as showing what hour is in progress. So with the more slowly-moving celestial bodies. They would serve well enough, at least some among them would, to show the *day of the year*, if we could only imagine that such information were ever required from celestial bodies. But it would be hopeless to attempt to ascertain the true time with any degree of accuracy from their motions. Now the moon really moves with considerable rapidity among the stars.* She completes the circuit of the celestial sphere in 27⅓ days (a period less than the common lunation), so that in one day she traverses about thirteen degrees,—or her own diameter (which is rather more than half a degree) in about an hour. This, astronomi-

learn of him without contradicting him when I differed in opinion from him: he could not in his old age bear such contradiction, and so he was afraid of me the last thirteen years of his life."

* If but one star or a few would periodically (and quite regularly) "go out" for a few moments, the intervals between such vanishings being long enough to ensure that one would not be mistaken in point of time for the next or following one, then it would be possible to determine Greenwich or other reference time with great exactness. And here we cannot but recognise an argument against the singular theory that the stars were intended simply as lights to adorn our heavens and to be of use to mankind. The teleologists who have adopted this strange view can hardly show how the theory is consistent with the fact that quite readily the stars (or a few of them) might have been so contrived as to give man the means of travelling with much more security over the length and breadth of his domain than is at present possible. In this connection I venture to quote a passage in which Sir John Herschel has touched on the *usefulness* of the stars, in terms which were they not corrected by other and better known passages in his writings, might suggest that he had adopted the theory I have just mentioned:—"The stars," he said, in an address to the Astronomical Society, in 1827, "are landmarks of the universe; and amidst the endless and complicated fluctuations of our system, seem placed by its Creator as guides and records, not merely to elevate our minds by the contemplation of what is vast, but to teach us to direct our actions by reference to what is immutable in His works. It is indeed hardly possible to over-appreciate their value in this point of view. Every well-determined star, from the moment its place is registered, becomes to the astronomer, the geographer, the navigator, the surveyor, a point of departure which can never deceive or fail him,—the same for ever and in all places, of a delicacy so extreme as to be a test for every instrument yet invented by man, yet equally adapted for the most ordinary purposes: as available for regulating a town clock as for conducting a navy to the Indies; as effective for mapping down the intricacies of a petty barony as for adjusting the boundaries of transatlantic empires. When once its place has been thoroughly ascertained, and carefully recorded, the brazen circle with which the useful work was done may moulder, the marble pillar may totter on its base, and the astronomer himself survive only in the gratitude of posterity; but the record remains, and transfuses all its own exactness into every determination which takes it for a groundwork, giving to inferior instruments, nay, even to temporary contrivances, and to the observations of a few weeks or days, all the precision attained originally at the cost of so much time, labour, and expense." It is only necessary as a corrective to the erroneous ideas which might otherwise be suggested by this somewhat high-flown passage, to quote the following remarks from the work which represented Sir John Herschel's more matured views, his well-known "Outlines of Astronomy." "For what purpose are we to suppose such magnificent bodies scattered through the abyss of space? Surely not to illuminate our nights, which an additional moon of the thousandth part of the size of our own world would do much better; nor to sparkle as a pageant void of meaning and reality, and bewilder us among vain conjectures. Useful, it is true, they are to man as points of exact and permanent reference, but he must have studied astronomy to little purpose, who can suppose man to be the only object of his Creator's care; or who does not see in the vast and wonderful apparatus around us, provision for other races of animated beings."

* It was this, doubtless, which led to the distinction recognised in the book of Job, where the moon is described as "*walking* in brightness."

cally speaking, is very rapid motion; and as it can be detected in a few seconds by telescopic comparison of the moon's place with that of some fixed star, it serves to show the time within a few seconds, which is precisely what is required by the seaman. Theoretically, all he has to do is to take the moon's apparent distance from a known star, and also her height and the star's height above the horizon. Thence he can calculate what would be the moon's distance from the star at the moment of observation, if the observer were at the earth's centre. But the Nautical Almanac informs him of the precise instant of Greenwich time corresponding to this calculated distance. So he has, what he requires, the true Greenwich time.

It will be manifest that all methods of finding the way at sea, except the rough processes depending on the log and compass, require that the celestial bodies, or some of them, should be seen. Hence it is that cloudy weather for any considerable length of time, occasions danger and sometimes leads to shipwreck and loss of life. Of course, the captain of a ship proceeds with extreme caution when the weather has long been cloudy, especially if according to his reckoning he is drawing near shore. Then the lead comes into play, that by soundings, if possible, the approach to shore may be indicated. Then also by day and night a careful watch is kept for the signs of land. But it sometimes happens that despite all such precautions a ship is lost; for there are conditions of weather which, occurring when a ship is nearing shore, render the most careful look-out futile. These conditions may be regarded as included among ordinary sea-risks, by which term are understood all such dangers as would leave a captain blameless if shipwreck occurred. It would be well if no ships were ever lost save from ordinary sea-risks; but unfortunately ships are sometimes cast ashore for want of care; either in maintaining due watch as the shore is approached, or taking advantage of opportunities, which may be few and far between, for observing sun, or moon, or stars, as the voyage proceeds. It may safely be said that the greater number of avoidable shipwrecks have been occasioned by the neglect of due care in finding the way at sea.

THE PARADISE FISH AND ITS NEST.

BY C. F. HOLDER.

THOSE who are familiar with the difficulties that attend the transportation of foreign and tropical fish to this latitude will appreciate the fact that two paradise fishes (*Macropodus viridi-auratus*) have been safely brought from India, and are flourishing in an aquarium in the museum-room at Fulton Market. They seem perfectly acclimated, and it is hoped that they may be introduced into American waters in the latitude from which they were taken. That they would prove an acquisition, no one could doubt after a contemplation of their movements, and I am indebted to Prof. H. J. Rice for opportunities for examining them.

In its native country the paradise fish has a somewhat unenviable reputation, being pugnacious in the extreme; so much so, indeed, that it is used by the Siamese very much as the Malays use the game-cock.

The native name of the fish is plakat, and in every town they can be found kept in glass jars and domesticated to a remarkable degree, the possibilities of which are well shown in the actions of the Fulton Market specimens. The Siamese use the fish principally in fighting, the method being to place them in glass vessels near each other, when they soon become enraged. When fully aroused they are placed together, and the result is attended with all the excitement of the prize-ring, the natives betting large sums on the contest.

The following account of the appearance when excited of a variety of this fish reared for fighting purposes is given by Dr. Cantor:—

"When the fish is in a state of quiet, with the fins at rest, the dull colours present nothing remarkable. But if two are brought within sight of each other, or if one sees its own image in a looking-glass, the little creature becomes suddenly excited, the raised fins and the whole body shine with metallic colours of dazzling beauty, while the projected gill membrane, waving like a black frill round the throat, adds something grotesque to the general appearance. In this state of irritation it makes repeated darts at its real or reflected antagonist. But the fish, when out of each other's sight, instantly become quiet. This description of their actions was drawn up in 1840, at Singapore, by a gentleman who had received a present of several from the King of Siam. They were kept singly in glasses of water, fed with the larvæ of mosquitoes, and had thus lived many months. The Siamese are infatuated with combats of these fishes, and sometimes their liberty, and that of their families, is staked on the issue. The licence to exhibit fish fights is farmed, and yields a considerable revenue to the crown."

After such a description one would naturally expect to see a fish of a somewhat ferocious aspect; but, on the contrary, the Fulton Market specimens seem to be thoroughly domesticated, and on the best terms of good fellowship. This is probably owing to the fact that the pair are male and female.

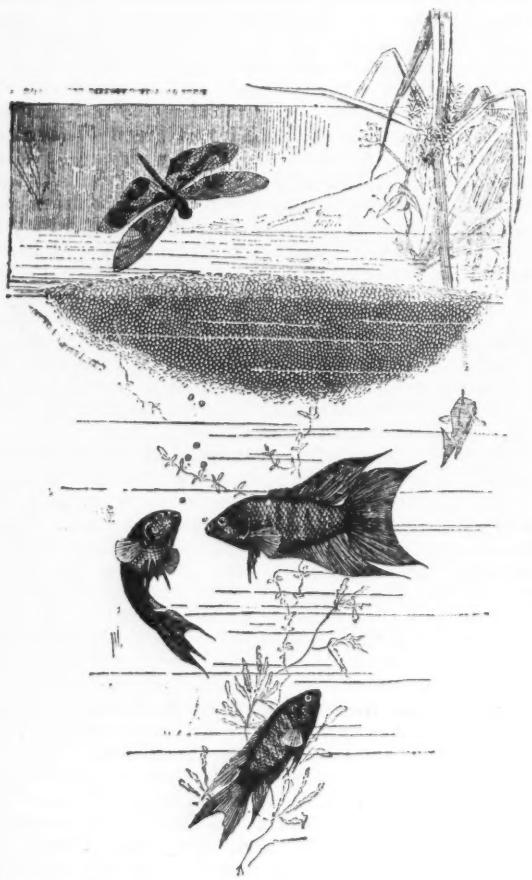
They are sombre little creatures, calling to mind our pomotis in general shape, though in an instant they seem to transform themselves into an entirely different creature, a paradise fish in the true sense of the word. They are about 3 to 3½ in. in length, of a sober greenish-brown hue, with darker and small spots. When moving along quietly, they look very much like some of the peculiar forms of gold-fishes with trilobed tails, and would, perhaps, attract but little attention. If anything occurs to excite them, the change is instantaneous; the dorsal and caudal fins develope into enormous fans, and appear to vibrate with excitement. Each ray springs into an erect position, booming out the living sail, as it were, so that the fish appears to have almost doubled its size.

The secret of this transformation is seen by an examination of the fins. The dorsal and anal fins are alike, and commence in the same relative position, as shown in the accompanying illustration. They extend back for half an inch, retaining the same height, then suddenly enlarge, the rays reaching gracefully away, like plumes, so that they extend beyond the end of the vertebral column an inch or more. Here they seem to join the tail, which is almost twice the width of the fish, also ending in points.

With such an array, the movements of the fish could not be other than graceful. The waving, plume-like appendages were constantly in motion, forming graceful curves as the fish darted about, expanding when they remained stationary, and closing when swimming, affording a continual change of picturesque attitudes to the observers. Every motion of my hand or finger against the glass was quickly noticed, and they would instantly arise to the surface. Professor Rice informed me that they readily fed from his hand, a common trick of the

common sunfish. I recently possessed one of the latter that not only took flies from my hand, but would thrust its head out of water as far as the pectoral fins to take them.

So active are the paradise fishes, alive to every movement, that they present a strange contrast to the clumsy golden carp in the same tank. All the fins become erect in a manner that reminds one of the sudden spreading of the peacock's tail. There was also another curious movement that seemed to quite change the expression of the fish. As soon as they met they remained stationary, face to face, for a moment, each expanding or opening the gill covers, so that they appeared puffed out at quite an angle, exposing the red gills quite plainly from behind. This salute, or whatever it was, was performed four or



The Paradise Fish.

five times in as many minutes; in fact, every time they met in their movements up and down the tank. At times they would face each other, and, while retaining the same relative position, move round and round each other, their plume-like fins waving behind and presenting an attractive appearance.

The nest-building, which Professor Rice has been fortunate in observing, is carried on, as is the rule with other nest-building fishes, entirely by the male. Approaching the surface of the water, he sucks in a mouthful of air with a clicking sound, and descends six or eight inches below, then facing the surface he releases the air in small mucous-covered bubbles, that rise to the surface, joining together, adhering, however, very lightly at first. Another mouthful of air is taken and other bubbles added, until finally a platform of these floats rests upon the water, forming a raft, perhaps four or five inches in diameter. Others are then added that tend to lift the upper layer, so that it has a convex surface, or resembles a watch crystal. Bubbles are added until the nest is three or four inches deep, according to circumstances, and undoubtedly it is often larger. In Professor Rice's aquarium the nests were, perhaps, not as complete as they would have been in open water, and the mass of bubbles was comparatively small and easily blown apart by the breath. Age would, however, soon render the nest more compact; fungoid growths would seal the bubbles together, and in a short time the nest would be of a consistence to resist the strongest breeze. When the fish had completed his labours, he began to chase the female about, endeavouring to drive her in the direction of the nest, but in this he failed, she probably not being ready for the maternal duties.

In their native streams the female deposits her eggs under or in the mass of bubbles; there they are held until hatched, the young at first feeding from the mucous spittle, if so it may be termed, of which the nest is made. Professor Rice suggested to me that it was possible that there was more architectural ability shown in the structure of the nest than would appear from a casual glance, and that the eggs were not deposited at random in the mass, but found their way into the upper portion, that he thought might be a pseudo air-chamber formed by the extreme upper layers of bubbles and the layer resting upon the water. Whether this is the case will be determined when the eggs are deposited. It would appear more likely that they are deposited at random, and cling wherever they are caught by the bubbles.

A large number of marine fishes deposit their eggs either upon the surface or in position where they ultimately rise, and those of the angler are enclosed in a long gelatinous ribbon; but in the paradise fish we find a decided improvement, as if the fish had learned by experience that if its eggs became separated they would fare badly; hence the bubble-nest was extemporised to keep them together at the surface, where, perhaps, in the disguise of a mass of froth, they float about, safe from all predatory enemies.—*Scientific American.*

JUST ONE BOOK.

To the Editor of KNOWLEDGE.

SIR,—Will you spare a few lines in your widely-read paper to plead with the tourist readers in behalf of the stay-at-homes who have no books to read. At this season many interesting and amusing works are purchased at railway book-stalls, and thrown aside after having served for the recreation of a few hours' journey. These would be greatly valued by the sick, the poor, the old and infirm, who have few pleasures but reading. The Kyrle Society, 14, Nottingham-place, W., will take charge (through their Hon. Sec. of the Literature Distribution Branch) of any books sent—and will see that they reach an appropriate haven either in hospitals, infirmaries, workhouses, boys' or men's clubs, or wherever they may be wanted. The applications far exceed the supply already. Magazines, whether of general interest or of a technical character, such as the medical or engineering, &c., periodicals are specially acceptable. I will not trespass on your space; those that enjoy reading will, I am sure, like to help us, and will all (if they can do no more) send us just one book. Further particulars will be sent gladly to any address by

EMMA S. BUSK,
Hon. Sec. Literature Distribution Branch Kyrle Society,
14, Nottingham-place.

Gossip.

By Richard A. Proctor.

With regard to last week's announcement as to the change of Knowledge to a monthly magazine after the last number in September, it has since been found necessary to extend the weekly issue until October 16.

The discovery of a new star in the great Andromeda nebula must be regarded as decidedly a point for us (Mr. Herbert Spencer, Cleveland Abbe, myself, and—well, I know no others)—who have maintained for several years past, that none of the nebulæ are external galaxies. For certainly, if there was one exception which even we might have been disposed to make, the nebula in Andromeda, with its great size, its proved stellar constitution, and its position (not obviously associating it with the stars) would have been selected.

The *Times*, which somehow seems unfortunate in its staff writers on scientific matters, has some singularly inexact remarks about the nebula, and the recent change. Thus, it says, "Sir William Herschel inferred, from the fact that some nebulæ could not be resolved into stars even with his powerful instruments, that there were many composed of the primeval cosmic matter of the universe." He did so; but this remark, applied to the Andromeda nebula, which has been shown to be stellar in constitution, is rather worse than out of place: it suggests entirely incorrect ideas.

Again, the writer in the *Times* remarks, "The varied forms assumed by nebulæ induced Laplace to trace the origin of the whole system to nebulous matter, and this despite the fact that no decided change had been noted in any particular nebula. His idea of the change he illustrated by referring to the trees in a forest, which show no change during a single glance, but show plants in different stages related to each other in order of time, to trace out which in a single instance the life of man or the duration of a solar system would be required." This is an altogether incorrect account of Laplace's views. He was led to his theory of the origin of the solar system, which the *Times* writer presumably means when he vaguely speaks of "the whole system," not by observing the varied forms assumed by nebulæ, but by observing the nature of the movements within the solar system. It was after he had already suggested and described his hypothesis, which was never regarded by him as a theory, that he recognised evidence in its favour in the varied forms of nebulæ. Sir W. Herschel long preceded Laplace in suggesting that, though we might never hope to follow the processes of change by which a nebula passes from one form to another, we might yet recognise them by comparing nebula with nebula as in a garden we compare trees of different age.

Finally the writer in the *Times* makes the following remarks:—"In Laplace's theory the sun was surrounded by an immense nebulous envelope or atmosphere rotating with it, which extended beyond the farthest member of our system. From this envelope several rings of nebulous matter were thrown off, and these rings finally broke up into globular masses, thus forming the planets. It is considered by Captain Abney that the theory of evolution of suns and systems from nebulous matter has received strong support from spectroscopic observations. Doubtless the discovery of Herr Hartwig (*sic*) will prove a stimulus to observers possessing large instruments, and lead to a careful watch for any similar changes which will aid in the solution, or rather the acceptation, of the nebular theory." This account of Laplace's hypothesis is full of inaccuracies. The sun was not according to that hypothesis surrounded by, but formed out of, the immense nebulous mass extending beyond the orbit of the farthest existing planet; again, if nebulous rings broke up into globular masses, forming the planets, the planets would travel in rings, which they persistently decline to do—only the asteroids adopting that comparatively undignified course. What Captain Abney has found in support of Laplace's nebular hypothesis is not regarded by astronomers as amounting to very much: the weight of spectroscopic evidence points to a theory in which the process imagined by Laplace plays a very subordinate part.

Lastly the appearance of a new star, or sun, suddenly, in the midst of a mass of already stellar matter, will most assuredly not lead to the "acceptation" of Laplace's hypothesis of the gradual formation of sun and planets out of gaseous matter. Laplace himself, who probably knew something about his own hypothesis, explained clearly, or rather urged strongly, that we must not expect to have any evidence of the actual progress even of such changes as he imagined to have taken place during the embryonic condition of our solar system,—and these changes, even if the occurrence of any of them could have been infinitely hurried, so as to come within human cognisance as observed events, would have been quite unlike what has been observed in the Andromeda nebula. The spectrum of Laplace's nebulous embryon of the solar system would have been assuredly one indicating gaseity and great tenuity—assuming always that that nebulous embryon ever existed: the spectrum of the Andromeda nebula indicates the presence of incandescent solid, liquid, or vaporous masses, shining through strongly absorptive vapours.

Readers of Knowledge will share our regret that Mr. Alexander is to leave us, and at the occasion.

With regard to his remarks on Darwin's use of the singular number, in the case of the word "progenitor," it would certainly be to misunderstand the theory of natural selection utterly, were we to image that he believed each species descended from a single pair. The whole theory is inconsistent with that idea. It may be remembered that Huxley in reviewing Darwin's "Origin of Species" cited the case of the Ancon sheep as apparently indicating the possibility of exceptions to the rule of natural selection. For in that case a new species seemed to come into existence *per saltum*,—in using which word I intend no reference to the alleged convenience (Huxley is the authority) of the great length of the Ancon sheep's body for leaping over hedges and ditches. So also Mivart points to sudden variations as opposed to the principle of development by natural selection.

The fact is that the idea of races, species, nations, &c., being derived from a single pair, belongs to a very undeveloped stage of inquiry. So soon as men begin to recognise the complicated relations involved in such matters, and that such relations must have existed from

time immemorial, they see the absurdity of supposing that all lions descended from two ancestral lions, all whales from two ancestral whales, all Greeks from two ancestral Greeks, and so forth. It would in reality be not one whit more absurd for an historian acquainted with what is now known about nations, to begin a history of England by describing the English nation as descended from an ancestral English man and woman, Anglus and Angelina, who settled in the middle of the island, in the fourth generation from Noah and his wife, as it would be for a naturalist, acquainted with modern discoveries and researches in biology, to picture the human race as descended from two ancestral anthropoid apes. I cannot but think that Darwin would have been a little amused had he guessed that his use of the word "progenitor" would have been so singularly misinterpreted. One might almost as justly assert that Pope supposed a solitary male savage to run continually about the forests of the earth because he wrote, "When wild in woods the noble savage ran," and not "many noble savages, male and female, used frequently to run,—or walk when tired of running."

The *Daily News* in an amusing article about publishing-piracy in America, calls attention to Tennyson's quaint suggestion that those publishers who have made money by selling his books in America, without making him one penny the richer, should subscribe largely to the Gordon Fund. The idea is excellent; but I imagine the Gordon Fund will not gain more than the Poet Laureate has gained himself, from the proceeds of the American sales of his books. It would be such a surrender of principle, to admit in that way that Tennyson ought long since to have received money from the other side. Had he privately applied for a good round sum for himself, he would have had a much better chance of getting it from American generosity. For in the present state of the law every such payment, be it remembered, is a gift.

In passing let me remark that I tried,—indeed I did,—when penning the above paragraph to write Lord Tennyson (the first "T" shows clear traces of the attempt). But the Lordship and the poet fit as ill as Burns's gaugership with his poetry. By way of a jest Thackeray could write "Mr. Secretary Addison"; but only so. Thank goodness all our best poets except this one are left without any such attached tin-kettle—or call it a "tinkling cymbal." Imagine having to write King Shakespeare, or Duke Chaucer, or Prince Milton!

To return to American publishers. I have had probably as varied experiences with the American publishing trade as most men. There has certainly been good as well as bad in their relations with me. Messrs. Appleton were the first to take to a work of mine—that is, to take it. They published an American edition of my "Other Worlds than Ours," from which I received no direct profit. But I gained largely—though I can scarcely thank *them* for that—by becoming better known than I had been in America. I cannot but attribute to this a large part of the success I obtained in America in 1873-4—a time so bad that Bellew and Wilkie Collins both failed there, returning before the end of 1873 to this country. Messrs. Appleton directly helped me also—and for this I may legitimately thank them—to that success. Professor Youmans in particular, who has done more than any living man to improve the relations between literary men and publishers in the two countries, and who may be regarded as representing Messrs. Appleton in a literary way, may be said to have *made* my reception favourable.

Americans, by the way, have an unpleasing way—some of them—of calling the profits an English lecturer may make in America, "money taken by Englishmen out of America." I think an English author whose works have been pirated over the water may fairly take a very different view of the matter. A traveller who should meet in a social sort of way a gentlemanly pirate who held a quantity of what had been and should still be that traveller's property, would hardly think he was taking away other folks' money if he received in part payment a sum collected by the comrades of the pleasant buccaneer.

In other ways, Messrs. Appleton made me the *amende honorable*. They engaged my services, on very handsome terms, in writing the Astronomy and part of the Meteorology of the "American Cyclopædia." This, though it might seem but a business bargain, was in reality kindly and generous. It exposed them to fierce abuse from certain American astronomers who could not write, and certain American writers who knew little astronomy. These—both astronomers and writers—thought themselves wronged when an Englishman was engaged on what they regarded as their work. One of them revenged himself within a year by reviewing a book of mine in such blind wrath that he abused in company with it a book which was still in MS. in my desk. He was severely but deservedly rebuked in the leading New York papers. Another sent Messrs. Appleton a pamphlet pointing out that my account of the precession of the equinoxes was not new though perhaps not untrue, and presently distinguished himself by publishing a work on astronomy in which an explanation which was not true, though decidedly it was new, made its appearance. Whether I, or Messrs. Appleton, have been forgiven yet I do not know. Probably not.

The *Daily News* mentions that English publishers have not been free from blame, quoting one remarkable case where one of them not only stole an American's work but dedicated it to a person whom that American by no means admired. In like sort Messrs. Lippincott "took over" Chambers' "Cyclopædia," and modified it, without explaining what they were doing, by abusing English kings and queens and English rulers and statesmen. My own work has been curiously modified in the same non-explanatory way over the water. Thus, when I received the stereotyped proofs of my article on the Moon for the "American Cyclopædia," I found, too late for any alteration, that a most remarkable theory by a Mr. Boyle (I have always remembered the name because I felt like boyling over myself) respecting the existence of pools of water on the moon, had been added to it. There was eventually quite a disturbance over these pools, which were cast up at me by the astronomers and writers above mentioned. It was, indeed, when I explained where they came from, that I learned through Messrs. Appleton (who always thought my rejection of those pools very unfair) how indignant American astronomers and writers had been. I still stand by my opposition to the lunar pools; but I am bound to admit that as I had not, in returning the stereotyped proof, insisted on their being remorselessly cut out, Messrs. Appleton were justified in thinking I had accepted them. I had an idea, I

think, that their discoverer's name would be mentioned. It was an unfortunate business altogether. The moral, however, should be that no man's work should be tampered with without full explanation,—also this, that no matter should be stereotyped till it has been sanctioned by the author, or responsible reviser.

With Messrs. Scribner and with Messrs. Putnam's Sons, I have always had very pleasant relations. Messrs. Scribner did once urge my publishers in England to persuade me not to work so hard, as my books "crowded" each other. But there was nothing very unpleasant in that. So far as I know no pirated editions of my work have been published by either firm.

Messrs. Harper when recently publishing a cheap edition of one of my works, sent me a cheque, which I must perforce regard as a gift, in the actual state of the law,—or rather in the absence of any law of copyright between England and America. The amount probably corresponded to about the loss which I incurred during the first month after the cheap edition was published. But all the same, I considered myself fortunate that the work had not been taken over by one of the new race of cheap pirates, who not only pay nothing, but sell badly-printed copies of a man's books on bad paper, and badly sewn,—thus adding insult to injury.

Messrs. Funk & Wagnall also stand between the unfortunate English author and the horde of pirates just referred to. They sell cheap editions, and pay the author what the sale justifies,—every cent being in reality a gift, as the law stands.

Nathaniel Hawthorne abused the English publishers as thieves and pirates, and "hypocrites at that,"—because he maintained that the fault has been as great on this side of the water as on the other. In answer to this it is only necessary to point out that England has international copyright with every nation willing to make an honest treaty of the kind.

It is curious by the way how Hawthorne's coarseness came to the surface in a matter which moved him personally. Many Americans regard him as the most delicate of all writers; and he himself was too delicately-minded to bear association with his family circle. Yet this delicately-minded person could find no pleasanter way of mentioning that English ladies sometimes incline to *embonpoint* towards middle life, than by comparing them to cows.

In like manner Mr. Wilkie, editor of the *Chicago Times*, was shocked by the ill manners of Englishmen in wearing their hats when ladies are present in hotel corridors (for which there is this very excellent reason that the outer air is not excluded in England as in America from the interiors of hotels); yet this exceedingly delicate American, who considers that respect for the other sex should rise to reverence, or even as Mr. H. James, junr., suggests in "The American" should become a sort of religion, did not hesitate to hold a sick child in a sailing yacht in such a way that a lady's dress should be ruined (even having the gallant achievement carefully illustrated) for no better reason than that in his opinion the lady should have relieved the child's mother (who was also sick) of the care of it. In my copy of Mr. Wilkie's work, this incident is marked by a cross-reference in pencil to the passage praising the average American's intense reverence for women. Not that I would ridicule any attempt to inculcate due respect and attention, which some in this country as in America fail at times to show. But exaggerated nonsense about religious reverence, associated with gross (one may say brutal) coarseness,—*c'est par trop fort.* To show how far some will go in this direction the reviews of Miss Cleveland's works should be seen. That her writing is silly and stilted may be admitted; but she is called names, by these reverential persons, which an English costermonger might hesitate to use. Of course it is only in Republican papers that the sister of the Democratic President is so treated; but this is a point of no importance to the argument.

The *Amateur Photographer* records the artistic adventures of Captain J. Peters, of the Citadel, Quebec, who is said to be actually the first who has ever taken photographs of a battle while under fire. During the rebellion in the North-West he took about sixty pictures, a dozen of these being taken during the battles of "Batoche" and "Fish Creek," and *all under fire*, one of them during a volley from the rebels' pits *about* 150 *yards distant*. The exploits of the gallant captain speak well for his pluck and presence of mind, for the numerous operations required to make a negative, even on one of the improved dry plates, demand a steady hand and an amount of attention difficult to give when under fire. As to the quality of the pictures so produced, we trust we shall be enabled to judge for ourselves, and join the *Amateur Photographer* in the hope that Captain Peters will send copies of his unique "battle-pieces" for reproduction.

Reviews.

SOME BOOKS ON OUR TABLE.

A Practical Arithmetic. By John Jackson. (London: Blackie & Son. 1885.)—"It may be claimed for this arithmetic," says Mr. Jackson in his introduction, "that it is an entirely unique production, and that in no treatise extant are the same excellencies attempted, or even suggested . . ." Without absolutely endorsing this somewhat hyperbolical description given by the author of his own work, we may say that it is really what it professes to be, eminently practical; and that in his employment of the algebraical device of adding a negative quantity instead of subtracting a positive one; and in his conversion of the ordinary rule of three "stating" into a fraction, he has employed a more scientific form of treatment than that which these branches of his subject generally receive. He is very apt in contractions generally, and more than one of his devices for simplifying calculation will be found useful. The numerous worked-out illustrations of the text add materially to its usefulness. He has produced a school-book of real value.

Burnham Beeches. By Francis George Heath. Holiday Edition. (London: Wm. Rider & Son. 1885.)—This is the sixth edition of Mr. Heath's well-known description of one of the most delightful pieces of all our English sylvan scenery. It will not be forgotten how, through the exertions of the author of the work before us, the much-maligned Corporation of the City

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of London were prompted patriotically to rescue this glorious tract of primitive land from the hands of the speculator and jerry builder, and dedicate it to the public for ever. Incidentally Mr. Heath gives a short account of Stoke Pogis, rendered classical by Gray's "Elegy in a Country Churchyard." Four engravings from photographs of the "Beeches," four from the same number of Mr. Burket Foster's charming vignettes, and a map at once adorn and illustrate the volume.

High-Class Cookery Recipes. By Mrs. Charles Clarke. (London: W. H. Allen & Co. 1885.)—Mrs. Clarke, who is the Lady Superintendent of the National Training School of Cookery at South Kensington, has produced a work of unquestionable value in the volume before us. Nothing can be at once more methodical and lucid than her recipes, in which quantities, materials, and times are given in a manner which renders a mistake practically impossible. It must, however, be added that she fully justifies her selection of a title, inasmuch as her recipes are rigidly confined to high-class cookery; and that the struggling housewife with £200 a year *pour tout potage* will find Mrs. Clarke's dainty and delicious dishes but ill-adapted indeed to her pecuniary resources. All, though, capable of appreciating culinary artistic triumphs (and of paying for them), should lose no time in possessing themselves of so sure and certain a guide as is here offered to them by our authoress.

Land Surveying on the Meridian and Perpendicular System. By Wm. Penman, C.E. (London: E. & F. N. Spon. 1885.)—The practice of land-surveying in England is ordinarily conducted upon one of two extreme principles. On the one hand it is performed (and this in a large majority of cases) by the chain alone, sometimes with the aid of the old-fashioned "cross-staff;" on the other, with all the elaboration of angular measurement on the geodetical or trigonometrical system. The first method is easy but moderately inaccurate; the latter difficult, tedious, and operose, but possessing the undeniable merit of being rigidly correct. The Ordnance Survey of the United Kingdom supplies an example of its application; while stewards and surveyors in country districts still, as a class, adhere to the more primitive system. The object of Mr. Penman in the work now before us is to exemplify and recommend for adoption a trigonometrical system of surveying, which shall secure all the accuracy needed for practical purposes, without entailing the great amount of labour involved in the ordinary geodetical method. He gives minute instructions for the adjustments and use of the theodolite and chain, teaches the student how to measure his base line and obtain his primary and secondary triangles from it; how to determine its deviation from the astronomical meridian of the place; how to connect distant points, &c.; and finally, how to plot the results of his observations, and to make a map from them. All this is illustrated by the details of an actual survey, the map embodying the conclusions of which is appended to the volume. All the calculations are given at length, while engravings are scattered throughout the text. This is a book to be commended to the study of all who may have occasion to survey any moderately large area of land, and who may be content to take a (very) little more pains than usual to secure an accurate delineation of it.

London, Old and New; a Sanitary Contrast. By Ernest Hart. (London: Allman & Son.)—In this pamphlet Mr. Hart gives a sketch of London from the date of the Roman occupation of Britain down to the present day; showing how the sanitary regulations and appliances of the Romans fell into desuetude after they finally quitted Britain, and how mediævally filth became rampant, and, in fact, to a great extent, synonymous with religion. He then adverts to the improvement in sanitary arrangements which was initiated about the time of Henry II., and traces this down to the present day. The effect of progress in hygiene may perhaps be illustrated by the simple statement, that while from 1620 to 1643 the annual rate of mortality in London was 70 per 1,000, during the past four years it has declined to 20·9 out of every 1,000 inhabitants.

Sensations of Tone. By Hermann L. F. Helmholtz, M.D., &c. Second English edition, translated by Alexander J. Ellis, B.A., F.R.S., &c. (London: Longmans, Green & Co. 1885.)—If we were asked to describe this wonderful work of Professor Helmholtz in the most succinct manner possible, we might well do so by speaking of it as the *Principia* of Modern Acoustics. For assuredly to the Great Physicist of Berlin are we indebted for the most complete and exhaustive account in existence of that branch of science towards the elucidation and establishment of which he has himself so largely contributed. Beginning with the composition of vibrations, the wave theory of sound is expounded both experimentally and mathematically, the distinction between mere noise and music pointed out, and a lucid explanation given of what constitutes the quality of tone, and enables everyone at once to distinguish between the sound of any given note as rendered by the human voice, the pianoforte, organ, violin, or flute, &c. The manner in which what are called "Partial Tones" are separated from a fundamental note sounded by any of these instruments forms the subject of a succeeding chapter, and introduces us to our author's extremely ingenious "Resonators," by the aid of which these partial tones may be picked out and, as it were, isolated. Subsequently the qualities of tones are discussed, and the why and wherefore of harmony and discord made clear. Incidentally, the anatomy and physiology of the ear are treated on, and a new theory of the functions of certain of its anatomical elements discussed; while, in conclusion, the æsthetical aspects of the subject come under review, and an attempt is made to show why one sort of music is pleasurable and another painful to the ears. So far, we have dealt only with Professor Helmholtz's share in the volume before us; but we should convey but an inadequate idea indeed of its value and importance if we stopped here. In point of fact, the ably-executed translation from the original German occupies but 371 pages out of the 576 of which that volume is composed, the remainder being made up of Appendices by Mr. Ellis—which will suffer little, if anything, by comparison with the work which they so worthily supplement—and a capital index. We may, moreover, add that the translator has, in addition, enriched the work throughout with foot-notes elucidating and illustrating the text. In fine, he has, in conjunction with Professor Helmholtz, produced a work which should, and soon must, be on the shelves of every physicist, mathematician, and scientific musician in the kingdom.

Audeography, the New Shorthand. By Digamma. Lithographed from MS. (London: Bemrose & Sons.)—This is a work which may be commended to our occasional correspondent, Mr. J. Greevz Fisher, and others who fondly believe that they are practising a phonographic system—in the rigid sense of writing words as they are pronounced. "Digamma" knows better. "Whatever attributes," he says, "Phonography may enjoy, its most perfect exponent can never be accused of *writing by sound.*" Having reduced matters to this comfortable stage,

our author proceeds to develop his own system, which is apparently composed of diagrams of sea-gulls in flight, fly-dirt on windows, and worms which have been trodden on, similar to those which characterise most modern works on stenography. As "Digamma" attacks phonographers as a class, they will doubtless possess themselves of his book and answer him.

We have also on our table, *The Journal of the Society of Arts, The Child's Pictorial, The Season, The Medical Press and Circular, The Tricyclist, Wheeling, Bradstreet's, The Sanitary News, Le Franklin, The Belfast News Letter, The Northern Whig*, and, from the Messrs. Cassell, *Cassell's Household Guide, Cassell's Popular Gardening, Our Own Country, European Butterflies and Moths, The Book of Health, The Library of English Literature*, and *The Countries of the World*.

THE FACE OF THE SKY.

FROM SEPT. 11 TO SEPT. 25.

BY F.R.A.S.

THE usual examination of the sun will be made for spots and faculæ. The aspect of the night sky is shown on Map IX. of "The Stars in their Seasons." There will be a minimum of Algol on Sept. 12 at 6h. 54m. p.m. Mercury is a morning star, and attains his greatest elongation west of the sun (17° 51′) at 7 p.m. on the 18th. He may be seen with the naked eye about this time, glittering close to the eastern horizon before sunrise, by any one who will get up (or sit up) for that purpose. He exhibits a very pretty little crescent in the telescope. Venus is indifferently placed for the observer, and, moreover, her position steadily deteriorates. She is an evening star, and as a telescopic object is seen as a small gibbous disc. Mars, Jupiter, Uranus, and Neptune continue invisible. Saturn, though, is nightly improving in position for the observer's purpose, continuing to form a triangle with μ and ν Geminorum. He rises before 11h. p.m., when our notes begin, and just after 10 o'clock at night, when they terminate. The moon enters her first quarter at 6h. 14·8m. on the morning of the 16th, and is full at 7h. 54·7m. a.m. on the 24th. At this time she will be partially eclipsed. The first contact of her limb with the penumbra, though, will occur at 5h. 2·1m. a.m., and she will set (at Greenwich) at 5h. 45m., so that beyond a very slight darkening of her following limb nothing of the eclipse will be visible here. The occultations of fixed stars observable during the next fortnight are fairly numerous. To begin with, on Sept. 19, 13 Capricorni, a star of the 6th magnitude, will disappear at the moon's dark limb at 8h. 4m. p.m., at an angle from her vertex of 122°, and reappear at her bright limb at 9h. 23m. p.m., at a vertical angle of 272°. Later, at 9h. 33m. p.m., 14 Capricorni, a 5th mag. star, will disappear at the dark limb at an angle of 151° from the Moon's vertex, to reappear at her bright limb at 10h. 41m. p.m., at an angle from her vertex of 273°. On the 20th, 18 Aquarii, a star of the 6th magnitude, will disappear at the dark limb at 6h. 47m. p.m., at a vertical angle of 49°. It will reappear from behind the bright limb at 7h. 55m. p.m., at an angle of 305° from the vertex of the Moon. On the 21st, B.A.C. 7774, a 6th magnitude star, will disappear at the dark limb at 10h. 8m. p.m. at an angle from the Moon's vertex of 136°; reappearing at her bright limb at 11h. 22m. p.m., at a vertical angle of 283°. Lastly, on the 25th, μ Piscium, a star of the 5th magnitude, will disappear at the bright limb at 8h. 12m. p.m. at a vertical angle of 94°; and will reappear at the dark limb at 9h. 9m. p.m., at an angle of 233° from the vertex of the Moon. When our notes begin the Moon is in Virgo; but at 9h. 30m. to-morrow morning she crosses into Libra. Passing through Libra, she arrives, at 8 a.m on the 14th, on the confines of the narrow northern strip of Scorpio. This she takes 10 hours to cross, and at 6 o'clock the same afternoon enters Ophiuchus; whence at 4 p.m. on the 16th, she passes into Sagittarius. At 6.30 a.m. on the 19th she quits Sagittarius for Capricornus, and Capricornus in turn for Aquarius at 3 a.m. on the 20th. She is travelling through Aquarius until 7 a.m. on the 23rd, when she enters Pisces. She has not completed her journey through this huge constellation when our notes terminate.

THE Dutch State Railway authorities have been conducting experiments on the behaviour of different paints for ironwork. They have shown that red lead best resists the action of the atmosphere. It was found, also, that the coat holds better on iron plates cleaned by pickling than when the plates have been scraped or brushed. The trial sheets were pickled with hydrochloric acid, washed with warm water, dried, and oiled while still warm.

Our Inventors' Column.

STATE-ROOM LADDER.

[Patent No. 14,065. 1884.]—This invention, by Mr. Thomas James, of 25, Earle-street, Liverpool, is intended to meet the "upper berth" difficulty in passenger vessels, the difficulty and danger of reaching or leaving the upper berth in rough weather forming one of the most serious discomforts which sea-travellers have to undergo. In its simpler form, the invention consists of a wooden step-ladder 6 or 7 ft. high, joined to the bulkhead or partition forming the head or foot of the berths by a support about 3 or 3½ ft. long. The support is connected to the ladder and to the bulkhead by hinge arrangements, so that the ladder can be drawn out for use, and, when not required, closed up against the bulkhead out of the way. To add to its security, strong hooks are attached to the side to clamp the edges of the bunks. When drawn out, the foot of the ladder will be about 4½ ft. and its head about 2 ft. from the bulkhead, the foot being kept in position by a cord, and the ladder kept closed by a clip, catch, or similar arrangement.

By means of this ladder, the upper berth passenger can reach his berth without danger or annoyance to the lower passenger. It will be much easier and safer to use than ladders hung to or leaning against the upper berth, which slip and fall with the least motion, while, after using it, the ladder ceases to be an obstruction in the state-room, as with ordinary ladders.

PUBLIC TELEPHONE CHECKING MACHINE.

[Patent, No. 13,543. 1884.]—This machine, by Mr. Mann, of Manchester, consists of a clock train and a rocking lever, fixed in a box containing upper and lower compartments. The upper compartment contains the connections to battery, line-wire, and transmitter, and mechanism in connection with the clockwork for regulating the time during which the connections are made for speaking. The lower compartment is a receptacle for metal tokens or coins, which are used to set the mechanism in motion.

The tokens or coins are placed into a hole in a brass segment, and are passed on to the rocking lever by turning a handle; the lever is thereby canted over until the coins slide off and drop on to a tray, allowing the lever to return to its original position; simultaneously, electrical contact is made, which transmits the "ring-up" signal to the central-office, and a bar is raised opposite to the slider, and retained in position by a crank. On receiving the "return-ring" from the central-office a button is pressed, thereby raising levers, which complete the transmitter primary circuit, changing the signal from OFF to ON, and liberating time disc. The necessary connections with the central-office are now complete until a notch in the disc comes opposite the end of one of the levers, and the contact pin against the spring, when further movement is arrested. On the receipt of the "reply-ring" from the subscriber, the button is again pressed, completing the transmitter circuit for a definite period of time, during which the disc travels round until the above-mentioned lever drops into the deep end of a slot and transmits the "ring-off" signal; simultaneously, the apparatus is restored to its original position, and the signal is changed from ON to OFF, when the cycle of operations is complete. By means of a releasing arrangement the tray is allowed to fall every time the instrument is used, thereby allowing the coin of the previous operator to drop into a drawer beneath.

SAMPHIRE SOAP.

WHEN the mountain declined to come to Mahomet, Mahomet, with a fine sense of the fitness of things, went to the mountain. Those whose inclination and means enable them to sojourn at the sea-side, are of course able to indulge in the health-giving luxury of sea-bathing To those prevented by circumstances from doing so, the Messrs. J. C. & J. Field offer a substitute in their Patented Samphire Soap, for which a Gold Medal was awarded to them at the Health Exhibition in 1884. No attempt has been made in the specimen before us to load this soap with the heavy perfume of any essential oil. There is a whiff of the sea in the scent which it emits in use, which is eminently suggestive of its hygienic properties. It is very pleasant on this account to use.

THE death is announced of an eminent French railway man, M. Paulin Talabot. Born in 1800, he passed unscathed through all the tremendous vicissitudes of French politics, and died at the ripe age of eighty-five. Even then his death appears to have been the result of an accidental fall. M. Talabot will long be known and remembered as the originator of the vast system of railways bearing the designation of the Paris, Lyons, and Mediterranean. M. Talabot was also actively associated with great dock works at Marseilles, as well as with other important public undertakings.

XUM

"Let knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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OCULAR SPECTRA—DARWINISM.

[1917]—It is with sincere regret I pen these lines, as they are probably my last effusion to KNOWLEDGE—at any rate for some time. In a few days I shall be starting for a voyage half round the globe, in the hopes of hindering for a while the ravages of an incurable disease. But, before I go, I feel it incumbent on me to reply to the Conductor's note (1864) and to your constant correspondents F. W. H. and Mr. Cave Thomas (1861). F. W. H. requests that I will read Haeckel's "Pedigree of Man" for myself. I own the soft impeachment. I have not read Haeckel's "Pedigree of Man." I accepted as accurate F. W. H.'s quotations. I did not think it necessary to spend *x* shillings on the book (I am within reach of no good library) to prove that Haeckel's syllogisms were fairly sound when I cannot admit his definitions. But, if ever I come within reach of the book, I will read it, and, if possible, let F. W. H. know the result.

Mr. Cave Thomas says (instead of answering my objection to his statement that "ocular spectra have no *external existence whatever*") that it is not clear that I am intimately acquainted with the phenomena in question. If it will help Mr. Thomas in any way, let me assure him that I am, and have been for many years. Mr. Thomas says I object to the statement that ocular spectra had no *objective* existence. I know nothing of objective or subjective. I am perfectly willing to agree with Dr. Lewins, if he wishes it, that everything is subjective, or with somebody else that everything is objective; but I should not feel much wiser. What I objected to was "external existence whatever." I was under the impression that in such discussions external meant physical, and that the nerves of the eye were as much external as the pigments on the leaves of the spectra book. The only thing that can possibly have no external existence is the mind which perceives. Every sensation must have a corresponding physical phenomenon. Even if the mind can excite sensations, it can only do so by first acting on the matter which produces them.

The Conductor's note is, "Mr. Alexander should go to Darwin's books for Darwin's ideas." But I have gone, and when I went I took notes. I grant it is a dozen years ago, but I still have the notes written, with Darwin's books at my right hand. It is true Darwin never speaks of a single pair, but nevertheless he uses the term common progenitor in the singular, and he certainly means that the two branches, man and gorilla, meet the common stem higher up than the point at which the carnivora meet it.

I am under the impression also that he uses some such argument as follows to account for the peacock's tail. A cock bird of the pheasant genus by a sport of nature developed a tail with a brilliant spot or spots. This so attracted the admiration of the hen birds of his day that nearly all the next generation of cock pheasants in his locality had spots on their tails, and so on for each succeeding generation until the peacock in all his glory. What I wished to draw attention to was that Darwin seemed hardly satisfied with the explanation that it was the nature of plants and animals to evolve higher types. He tried to show how each species had varied, and that generally it was due to natural or to sexual selection. Darwin seemed rather to come to the conclusion, that if left alone variations had a natural tendency to revert to the original type.

JOS. W. ALEXANDER.

AMERICANISMS: "A BIT."

[1918]—The term "bit," in my time in the States, beginning in '48, was applied to a small Mexican coin, value on its face for six and a-quarter cents. It passed current for six cents, and was known by the name of a Mexican bit, or a fippenny bit as pronounced. There was in circulation at same time a Mexican coin of double the value of the bit (*i.e.*, twelve and a-half cents), and this coin was known by the name of a Mexican sevvey. The common expression "that's a sevvey, or that's a bit," to distinguish either from a five or a ten-cent piece, was in general use up to the year '52. From this date onward the word sevvey and the coin disappeared; but the term "bit" was applied to five cents, and occasionally to three cents, but seldom to ten cents. The origin of the terms date from the introduction of the coins by the U.S. troops on their return from the Mexican War, which ended in 1847, and the coins came into free circulation in the middle and southern sea-board cities in the years named. At the present you would not find a coin of either denomination in the States, but the term remains. It was in Mexico that the late General Grant first saw active service. J. BYRME.

MISPRONUNCIATION.

[1919]—Another instance of "words in common use among the natives (of India), but derived from English," is to be found in the expression "Jam do," generally employed by the signalmen on the Indian railways when they desire that a danger-signal, or one implying that the line is "jammed," or blocked, should be exhibited.

G. H.

THE GAME OF DRAUGHTS.

[1920]—I am glad to see that Mr. A. E. Hodson, in letter No. 1884, does not let the assertion quoted in letter No. 1856, to the effect that the game of draughts is played out, pass unchallenged. In addition to Mr. Hodgson's remarks, I would like to quote an extract from the *Newcastle Weekly Chronicle* for April 24, 1880, where we find a few figures given to show that there is at least a *little* play left for those who wish to amuse themselves with draughts, or "checkers" as the Americans call the game.

"A young man (A. L. Myers), a clerk in an hotel at Wilmington, O., was fancied and taken along by a travelling artist on account of his great skill with the pen and brush. Being a checker player besides . . . he said the beauties of the game captivated, and its capabilities fairly astonished him, and he intended to turn eastward and locate in some great checker centre, where he could indulge his leisure in contests with players of note. He fancied Philadelphia. This young aspirant to checker fame certainly filled the measure of his ambition, for he discovered a draw for the whites in a variation of the 'Old Fourteenth' opening that stood in Sturge's work for seventy-five years as a sure win for the black men, and so pronounced by every famous player. . . ."

Lastly, R. E. Bowen, one of the ablest analytical and impromptu players living, gives these interesting figures as to the inexhaustibility of checkers. He says:—"To know how many variations we shall have, we have only to decide how many moves there shall be in a game. The match played between Wyllie and Martins in 1864 seems to be about an average. There were sixty-two games and 4,001 moves, average over sixty-four moves to a game—suppose we make it sixty. I find we shall have the following surprising number of variations:—1,152,921,504,606,846,976. If 40,000,000 people could play together at the same time, each couple playing one game every ten minutes, ten hours a day, and three hundred days a year, it would take them one million six hundred thousand two hundred and seventy-nine years to play the above number of games. If the games were printed in a series of books, 2,000 variations in each book, they would make 576,460,752,303,422 volumes. If these books were the size of the 'American Draught Player,' they would form a wall 200 ft. wide and 590 high around the world—25,000 miles—and yet we hear men talk of grinding up all its wrinkles. The game of checkers is far more profound than human knowledge can fathom: its ever-varying position cannot be solved. The true position will never be written; though one had the brain of an Anderson, the years of a Methusalah, and the wealth of a nation, he would not unfold a hundredth part!"—(Originally published in the *Turf, Field, and Farm.*)

From this extract we learn that we are liable to attacks by some who imagine the game is exhausted, but a little theoretical analysis will soon dispel this illusion. Mr. Bowen is no mere talker. In 1880, he published 940 variations on the "Bristol" opening, commencing from the *third* move of the trunk game, and probably in half-a-dozen years, a hundred improved methods of play will be discovered on these games. But should any player become tired of draughts and fancy he knows all about it, I can safely recommend him to the Polish game on the Major board of 100 squares to drive any remnant of conceit out of his mind. The British champion

draught-player, Mr. James Wyllie, gives as his opinion that chess and draughts are "magnificent but navigable rivers in comparison to Polish draughts, which is as boundless and unfathomable as the mighty ocean. Nevertheless, there is more in English draughts than the wisest of us can comprehend in a life-time." So much for the opinions of the champions. J. WALLIS.

ON THE INDIAN WEAVER BIRD.

[1921]—Among the many marvels exhibited out here by nature with a liberal hand, none, I think, can approach the pendulous nest of the Indian weaver, or, as it is more familiarly known, the Baiya-bird. It is a finch, and its African cousins are known as sociable gross-beaks, and are famous for their aggregate straw-nests. Our baiya is *facile princeps* among bird architects, inasmuch as it virtually launches its frail pendulous nest from nothing into nothing.

All other birds have a foundation of some sort or other to commence from, and their nests, more or less, rest upon, and are supported by such foundation, but this bold and unique architect, starting, say, from a straw in the the thatch of your bungalow, or from the spiny end of the pinnule of a date-palm, or from the thorn of a mimosa, launches forth its wondrous structure to the fostering care of the atmosphere, being well aware that it will for ever know but little rest.

Careless alike of zephyr or gale, just moving under the kiss of the former, or agitated by the blast of the latter, the brave little birds resolutely carry on their building and nesting operations.

Why do they affect pendulous nests? When I was at the Cape many years ago, one of our boyish haunts was a large oval willow-fringed pond, each tree of which was hung with the waving pendulous nests of the weaver birds.

We were greatly impressed with them, and more so with the reason assigned for them by Herr Jurgens, the owner of the pond; the nests were pendulous to keep off snakes and monkeys. We were obliged to be satisfied with this explanation, though there were neither snakes nor monkeys in the neighbourhood. The reason is equally difficult out here; for neither snakes nor monkeys could possibly reach the nests. The work of construction, simple enough to the little architect, is one of great magnitude to the observer, and at times difficult to follow, even under the closest observation; for it must be borne in mind the little bird works downwards literally from nothing.

Note that straw projecting from the thatch of your verandah, for a golden-headed cock baiya has spotted it too. Perhaps you had wondered what all the chatteration in the adjoining neam-tree was about. But you did not for a moment dream that a colony of weaver birds was going to monopolise your verandah. But so it is; and presently you see a weaver hovering around that straw with a long streamer of green grass in its beak; and, while you look, in some marvellous manner, one end of the grass ribbon is fastened to the straw, how, you can't say, for the process is so rapid. After that it is hopeless to attempt to follow the marvellous downward progress of the little architect, but you see the fairy fabric steadily lengthening downwards towards completion.

The only two points you can fix are—at first, the little bird weaver on the wing; then, when it has a footing, it works downwards, clinging to the apex of its nest.

Baiyas almost always build from the date-palm (*Phœnix Dactylifera*), or from the babul (*Acacia Arabica*); and, what is very curious, they prefer the neighbourhood of railways, and each season they build fresh nests in fresh localities.

There has been much fanciful writing about these nests, some writers describing the basket-shaped nest of the male, in which he perches and surveys approvingly the work of the colony. This is simply an unfinished and abandoned nest. There is another fable which has equally no existence, that of the firefly stuck in to illuminate the nest.

The only real story lies in the fact that some of them weight their nests with mud; but this is the exception and not the rule. When the mud does exist, it is found on the little ridge between the bowl of the nest and the tube of exit.

Wonderful as an architect, this little bird is equally wonderful as a comic actor of the highest order. So docile is it, and so apt to learn, that it may be taught anything.

Native women wear little discs of coloured and gilded glass on their foreheads. A lover will tell his baiya to bring him the disc from his lady's brow, and the command is at once obeyed. Or he will bid it take a cardamom to her lips, with equal success.

A silver two-anna bit may be dropped into a well, and, arrested in its flight by the baiya, be brought back to the hand of its owner.

But these are comparatively minor performances. Let us attend to this man, who presents himself with a troupe of performing baiyas, all of whom are prevented from flying away by a soft thread passed round their loins. Making his salaam, he asks permission to exhibit; that accorded, he commences his patter:—

A Sepoy has deserted to the enemy, has subsequently been captured, and is now before them. He is to be tried by court-martial, and, if convicted, is to be blown from a gun. The traitor is placed on the ground, and takes up a dejected position; the court is also deposited, and at once commences chattering. Presently an ominous silence ensues, during which a little cannon, a ramrod, and a pellet of gunpowder are produced and laid ready. One baiya takes up and drops in the pellet, another drives home the ramrod, and a third seizes the cord of the trigger.

While a pinch of powder is being placed on the touch-hole, the prisoner, with drooping head, takes up a position two feet in front of the cannon; the court now draws up in a solemn line behind the cannon, and one takes the fatal trigger-cord; bang goes the piece, and the culprit drops; the court hops up, and forms a circle of chatterers around the body, which suddenly revives, and a free fight all round ensues.

After this military spectacle, we are treated to a religious one. The man rigs up a little wooden mosque, on the platform of which the members of the late court-martial take up their places as a line of worshippers, led by a moulvie. Under his guidance they accurately go through the nimaz, and then hop off and assist in dismantling the mosque.

Such are some of the interesting features exhibited by this interesting little finch, and they illustrate strikingly its constructive and imitative powers. R. F. HUTCHINSON, M.D.

Pachmari, July 26, 1885.

P.S.—We have two other weavers, or rather sewers, out here, each very wonderful in its way—the dear little mite of a tailor-bird, which sews the edges of leaves together for its nest; and the fierce mata, or great red ant, which sews together the edges of a terminal bunch of mango leaves. Approach one of these nests carefully, and give it a tap, in a moment the exterior will be covered with fierce brown-eyed warriors, all standing erect on their hind legs, and discharging formic acid into the air, the effects of which are soon felt in your eyes if you are near enough. Those who are afraid of the yellow wasp send for a red-ants' nest, and place it near that of the wasps, which clear out in no time.

PHILOLOGICAL.

[1922]—Tennyson and Wagner have made us familiar with an alleged "Holy Grail." Unless there is positive evidence that "Sangreal" is two words, there is, I think, a much more obvious origin.

It was fabled to be the vessel of which Jesus, at the Last Supper, said, "This cup is the new covenant in my own blood." Now, the linen napkin on which the Host lies at Mass is called "corporal," the receptacle of the body. By analogy, the chalice should, or might have been called "sanguinal." In Spanish (and other Romance dialects, probably) *sanguis* becomes *sangre*, *sangrinale* would then become *sangreăl* (three syllables). There you have the natural name of the vessel at once, without any "holy," or any "grail."

"Whitsuntide" has never had its derivation settled; but it seems allowed that *sun* is part of the word, and does not belong to *Sunday*; so that we should pronounce, not "Whit Sunday," but "Whitsun Day," This is the Feast of the Holy Ghost. "Wit," in primitive English, signified "spirit" as well as "ghost" did; "saint" was a Latin word learned from the Church services. Then would not "Wit Saint" be likely English for "Holy Ghost?" These suggestions are so beautifully simple that I fear that, if true, they would have occurred to somebody before. HALLYARDS.

A GOOD TRICYCLE FOR A HEAVY WEIGHT.

[1923]—In reply to "Sixteen and a-half stone," the best tricycle for a rider of such a weight would be a front-steerer; either Starley's Salvo or Starley & Sutton's front-steering Meteor, he would find a specially strong and safe machine well-suited for his purpose. The Globe Leni is a well-made machine, with which I have no doubt he would be satisfied.

I would recommend him on no account to have any machine that is convertible. Single machines, being simpler, are much less liable to get out of order. JOHN BROWNING.

TRICYCLE.

[1924]—If Mr. Browning (whose series of articles on matters connected with bicycles and tricycles have been of much interest) would kindly let your readers know whether he has tried the Crypto-Dynamic Two-speed Gear, to which the gold medal has been awarded at the Inventions Exhibition, and if he has tried it, with

what results, I think it would be very useful to persons hesitating as to its adoption. Many authorities have spoken highly of it, but I should like Mr. Browning's opinion thereon. G. W. G.

LETTERS RECEIVED AND SHORT ANSWERS.

One who, &c. I have not seen the paragraph about the vegetarian society, so that your attack has been misdirected. Nor have I attacked sunspottery (an abominably ugly word which I only quote from your letter, never using it myself). As for the Astronomical Society, I have never even thought of attacking it anywhere. I should have to withdraw from it first. But possibly you did not know I am a Fellow of the Society. I have never to the best of my knowledge and belief read one line of the *Dietetic Reformer*, or expressed any opinion about it, good, bad, or indifferent. You are all at sea. *Did* I "get into a mess with another well-known astronomer"? I have no recollection of the circumstance. I imagine you are at sea there also. "Take your word!"—the word of one who writes anonymously! That is asking too much. There is always the bare possibility that such a man may by some accident speak the truth. But the chances are enormously against it. It is safest at any rate to read everything he may aver by the rule of contraries. I adhere to my opinion that I have seen your writing before, and naturally I am strengthened in the opinion by your denial.—R. H. Barrett. I fancy the author of that review had heard the "hysterical shrieking" he referred to. *You* write sensibly enough. But all total abstainers do not either write or speak so calmly and pleasantly. "Practically, if not totally, abstainers"—what would that mean? I fancy it would include me. For certainly, the alcoholic liquor I take in a week, would be thought by many who are by no means heavy drinkers, to be a moderate allowance for a day. It is the men who see hell in a half-pint of beer whom the reviewer had—I suspect—in his mind's eye.—J. The point is of more interest than you seem to think. I wish you had indicated the particular Americanisms which you "have heard all your life in the very centre of England." Some, I knew, were good old English, But have you heard "no-account" as an adjective, "allow" for *assert* or *believe*, "not anything else" for *just that*, "approbate" for *approve*, "at that" for *added to that*, "the balance" for *the rest*, "bee" for a gathering of friends, "biscuit" for soft rolls, &c.? I have heard more "dialect" than you seem to think, and have read largely old English books and plays; but I should regard as an Americanism a phrase which, though English in origin and still used in parts of England, is understood by *all* Americans. The expressions "my *word*" and "no *fear*" in like manner I regard as Australian, though they are often enough heard in England. "I guess" is found in old English writers, and in some as late as Locke's time; yet it is an Americanism now. One often hears "I reckon" in England even to this day; yet it may be called an Americanism of the Southern States, because there used constantly. I wonder by the way how many expressions like "I want to know" (to express surprise), "I swan to man" (as a euphemism for "I swear to God," and the like, can be traced to an English source. Of course "You may bet your bottom dollar" is as necessarily American as "You pound it" (which I suppose means, "You may wager a pound on it") is English.—Hallyards. You are right. There has been misunderstanding. Certainly I never saw the letter you sent after me. I should not have been very much surprised by the remarks of that American (though a brother Cantab might have known better than to be misled by them). My being invited by the editor of the American "Cyclopædia" to write the astronomy for that work, created a simple frenzy of anger among certain Americans who had expected to be asked. Still I have said (and thought) so many pleasant things about American students of astronomy, that I might have hoped to be more fairly construed; doubtless there were mistakes on both sides; I overrated them and they underrated me: we need not rate each other. One of the most amusing examples of the feeling you refer to came to my knowledge at Washington. An American lady remarked to the wife of a well-known astronomer (or rather mathematician) at Washington that she was glad I had come to live in America: "Are you?" said Mrs. N., "well, I'm not; America doesn't want Proctor; it has N.!" This was particularly amusing to an unofficial student of astronomy, like myself, utterly innocent of any idea of trespassing on that official astronomer's manors. But that is the worst fault of official science; your scientist with a salary growls over it as a dog growls over a bone which he fancies every passer-by hankers for. Of course, I had unwittingly taken N.'s expected bone, but I had not gone after it; I was invited to take it; and as he is not a good writer, no one but himself had expected he would have it. I remember the same man groaning in spirit, in conversation with myself, because more was known about Mädler in America than about any American astronomer. I believe by the way that no one has done so much or one-tenth so much as I have to make American astronomers known to European readers. I am for my own part slow to imagine envy, which seems to me a strange, and must be a most uncomfortable feeling. My ideas about that vice were impressed on me very strongly when I was a boy. I used to see almost every day, at Chelsea, the Cadogan motto on old Cadogan pier (then new): *Qui invidet minor est*. I understood the words ("he who envies is less") but not the sense. Asking my father the meaning of the motto, he not only told me, but impressed the thought deeply on my mind by adding to his interpretation these words: "My boy, you will have to acknowledge yourself less than others often enough as you go through life; but try *never* to acknowledge it by envy: envy is the meanest possible way of admitting inferiority." Since then, in watching my own mind, I have learned to look with suspicion even on the feeling of emulation, unless it comes, as it should, in company with hearty admiration. The companions of Envy we know—does not the Litany tell us who they are?—Hatred, Malice, and all Uncharitableness. With regard to the letter to the acting editor, there was nothing in it to move anger. I am sorry I judged you wrongly; but your remark to him that he ought to feel so and so about such and such matters, seemed to me rather unfair. (I acquit you now freely of intended unfairness. I only found out, at that point, that I was reading a letter not addressed to myself.) Unless I deceive myself, and I don't think I do, you are utterly mistaken about my temper, as I think I told you in 1882. I know I was much readier to be warm ten years ago than I am now. I have even been somewhat anxious, in a passing sort of way, lest Wendell Holmes's explanation might be the right one, that mellowing indicates over-ripeness. I certainly do not care two straws *now* about some things which used to stir me somewhat at the time when you say I was "extremely and unnecessarily courteous to you." But are you not a little apt to misunderstand things? For example, that "Sadie D. Crowley" joke of mine. "Disingenuous to disavow!" Good gracious! what an interpretation to put on what I said! An impertinent newspaper writer had spoken about a number of strictly private and personal matters, with that curious mixture of truth and falsehood—one truth to fifteen fibs—which makes their rubbish so unpleasant to friends and relatives of the persons they drag into their columns. Among other blunders he got two mistakes (*not* misprints, but blunders arising from his ignorance of the families he pretended to talk about) in one name! Disavowing that doubly-blundered name was my way of casting deserved ridicule and condemnation on the whole preposterous story. As you yourself point out, the right name was published—in the right way—soon after: that should have prevented you from adopting so absurd a notion as that I wanted to disavow the matter, disingenuously or otherwise. Besides, you ought to understand and sympathise with my indignation at what assuredly was gross impertinence. How far my wrath has been moved "*in æternum*" against you by the G. E. matter, you shall judge from this, that, on my word, if any one had asked me, just before I read your letter, (I mean your last one, to which I am now replying) whether you were or were not one of those who had taken part in the attack I deprecated, I should have been quite unable to answer. I do not now remember what you said, or whether I read anything from you on that subject. Did I reply to you by name?—Your coleopterist priest was mistaken, as my bank-book would testify. In justice to a contributor you ought not to have quoted his remark. Your praise is as little deserved as your censure; I have neither the splendid genius nor the hot temper you imagine. I have worked as well as I could and as hard as I could, where I found work to do, and under difficulties which few would guess; but any man of decent capacity who cared to try, on the same lines, would, *me judice*, have got through the same amount of work and done it as well. It is the want of resolution and will, and perhaps the want of occasion (I don't say of opportunity, for I have not been very fortunate in opportunity) which has kept many out of my field of work.—I should have written what I have, privately in reply to your private letter; but for the wish expressed at the end of it. The readers of Knowledge (those at least who, having read what I said before, read this also) can gather from my reply that we shake hands in all good fellowship. I am going, however, to offer one piece of advice which I trust you will take as it is meant. Such sayings as those of your French priest, your American astronomer, and other persons unnamed, ought never—in my opinion—to be repeated. In some cases—as in that of the American astronomer, whom you describe as one of my American friends—such stories are calculated to leave a vague but unpleasant effect. For example, I have but one friend among American astronomers. I had another, who is dead. I am fully certain that neither of these, both being to my knowledge gentlemen of noble disposition, said the enviously malicious and untrue things you report. I am left, if I think about the matter at all, to attribute the remark to two or three others whom I have met; but of whom I do not know enough personally to decide whether they *can* or can *not* be ignoble enough to fit into the story. And as regards the publication of such things, even to

ridicule them, you may not know, so well as I do by experience, the effect such publication invariably has on some minds. If you were to say in a letter in KNOWLEDGE, "They are so ignorant in—Basutoland—as actually to suppose that So-and-so"—naming some worthy bishop—"is in reality a Mahometan,"—you would find, soon after, some people going about asking "Is it *really* true, as reported, that Bishop So-and-so is a believer in Mahomet?"—Your moon magnification ideas are quite wrong, and in justice to readers I cannot print your letter. Your multitudinous telescopes would have overlapping fields,—the sky does *not* overlap. Your argument like Mr. Williams's about the appearance of the sun as supposed to be seen from moon during total eclipse, is based simply on misconception. I have tried to *explain*, not to *controvert:* and have failed. Mirage never shows non-existent things. And mirage has nothing to do with the apparently magnified moon. Your experiment when the range of the sky was reduced would have been more to the purpose if you could show that you diminished your consciousness of the moon's horizontality. My note of admiration honestly expressed my wonder at your being puzzled—with your wonderful facility at inventing explanations, possible or impossible.—A satellite could be released from its primary, or a planet from the sun, so far as never returning is concerned: but you definitely spoke of bodies travelling in straight lines. That indeed was your special point.—I never supposed, and certainly never implied, that you wilfully misquoted me. I thought I dealt very pleasantly, and as it were smilingly, with your rather resolute attempt to maintain that I had said what I knew I had not said. As for the "double haves," I decline to judge the English language by the French (which is full of incorrectness) or by any other. "To see" means seeing, "to have seen" means seeing in the past, and of either one may say, speaking either indicatively or conditionally according to the circumstances,—It *is* pleasant, it *was* pleasant, it *has been* pleasant, it *might have been* pleasant, it *would have been* pleasant, or anything else one may please, let Mark Twain or the French or any other grammar say what it will.—SAMPHIRE. Mr. Slack does not need to be told that the plural of the word "imago" is "imagines": he simply prefers "imagoes" as the plural of the anglicised word "imago"; just as we say "indexes" rather than "indices." There is enough affectation about such matters without asking for more. Do not know the exact nature of the change by which a lobster's shell turns red under the action of hot water.—IGNORAMUS. Ask why the whipping-top ceases to spin and you will not be far from guessing why a rotating planet needs no flogging.—COMMENTATOR. Your letters just received, like the others, are too mixed in structure: suggestive questions mixed with wild semi-religious fancies, and attempts at more or less positive answers about the unknown and even about the unknowable. Do not know "Gamma's" address. The letters are all ready for return as you request. But is the address at the head of your letter sufficient? As to the personal matter, regret rather than wrath was predominant, and unfortunately remains. Would that you had been in London to cancel as you think you would!—R. LEWINS. I must by your own account view Hylo-idealism from the standpoint of self; and if I tremble at it, or am otherwise affected by it, I tremble at self or am otherwise affected by myself. (And yet I am not myself in being so affected.) Well then, I must judge by myself, and judging by myself I reject Hylo-idealism as for me quite meaningless.—COURTNEY FOX. Thanks: shall have however sufficient reports.—C. WOOLLY. Thank you.—BERKS. Very probably.—S. F. B. PEPPER. Is that science worth acquiring?—J. JACKSON. Am away from back numbers and volumes. The publishers of a book ought to attend to such business.—W. S. C. The *millions* more likely to be wrong than the *one*. The lines are Shakespeare's, and mean that though art may find means to improve on nature, those means are of nature's own making. As an example one may take some fancy specimens of pigeons, which may be regarded as an improvement on the rock pigeon—an improvement obtained by artificial means—but through natural laws.—H. A. L. S. Chess will be duly supplied: but the freshness of Chess news is not a point we can regard as of very great importance. Exactness is much more important—just as (to take an illustration from the game itself) correct play is better than quick play.

THE FIRST AMERICAN FOUR-MASTED SHIP.—Early in August, the first four-masted ship ever built in America was launched at Rockland, Maine. This new craft is 2,628 tons burthen, measuring 291 ft. in length at water-line. The frame is Virginia oak, and the plank southern pine. The masts are solid, the main sticks being Oregon pine and 90 ft. in length. The main truck is 181 ft. above the deck, the main yards are 90 ft. in length, and the rigging carries 1,200 square yards of canvas. The cost of this craft complete will be about 150,000 dols., nearly £31,000, or about £11. 15*s.* per ton.—*Engineering.*

Our Chess Column.

BY MEPHISTO.

SCOTCH OPENING.

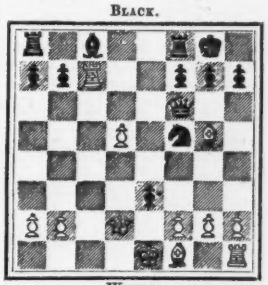
ILLUSTRATIVE GAME NO. 10.

IN reference to the attack of 7. Q to Q2 in the Scotch Gambit, we have promised to give some games actually played, showing the best defences against that move. In the annexed game will be found one way of meeting 7. Q to K2, that is by B × Kt. The "Chess Monthly" says that it is "a perfectly satisfactory continuation, which simplifies the position, if anything, in Black's favour." We do not quite agree to this. The continuation is right in itself; we think, however, that Black has better moves at his disposal. We hope to give a game to that effect before long.

GAME PLAYED AT THE NUREMBERG TOURNAMENT, JULY, 1883.

White. L. Paulsen.	Black. A. Schottländer.	White. L. Paulsen.	Black. A. Schottländer.
1. P to K4	P to K4	21. Castles	Q × P
2. Kt to KB3	Kt to QB3	22. Q × Q	R × Q
3. P to Q4	P × P		
4. Kt × P	B to B4		
5. B to K3	Q to B3		
6. P to QB3	KKt to K2		
7. Q to Q2	B × Kt (*a*)		
8. P × B	P to Q4		
9. Kt to B3 (*b*)	P × P (*c*)		
10. P to Q5 (*d*)	Kt to Kt sq. (*e*)		
11. Kt to Kt5	Kt to R3		
12. R to B sq. (*f*)	Castles		
13. Kt × BP	Kt × Kt		
14. R × Kt	Kt to B4		
15. B to Kt5	P to K6 (*g*)*		
16. B × P	Q to K4		
17. R to B3	R to Q sq.		
18. B to B4	Kt to Q3		
19. B to Q3 (*h*)	Kt to K5		
20. B × Kt	Q × B		

BLACK.



WHITE.

* The above was the position after the 15th move.

Given up as a draw.

NOTES.

(*a*) This is a sufficient answer as far as 7. Q to K2 is concerned. It is no disadvantage to Black to have White's Pawn posted on K4 and Q4, as the latter P is unsupported, and will not be able to move to Q5, on account of P to Q4, which follows next move. On the whole, however, the game assumes a drawn aspect.

(*b*) With the intention of getting his Kt into play if Black plays P × P. White has, however, yet another move which deserves notice, that is 9. B to QKt5, which, of course, prevents Black from playing either P × P, on account of 10. P to Q5, or Castling, *i.e.*, 9. B to QKt5, Castles. 10. B to Kt5, Q to K3. 11. Castles, KR, and White has a fairly developed position.

(*c*) Black has nothing better. If he plays B to K3 White would reply with 10. B to Q3, putting Black in an uncomfortable position, as White threatens P to K5.

(*d*) With a view to disorganise Black's game.

(*e*) If Kt to Q4, then 11. Kt to Kt5, and Black could not defend the BP so well as after Kt to Kt sq.

(*f*) White could have obtained a much superior game by playing 12. P to Q6.

(*g*) An excellent device to gain time. See diagram.

(*h*) If any other move, then Kt × B, followed by R × P.

CHESS PLAYING.

SIR,—The Chess Congress at Hereford, which you did us the favour to report, was a brilliant success. There arise, however, after-thoughts in the minds of many Chess players and non-Chess players—*cui bono* all this expenditure of time, money, and brain-power? I would reply, the result should be *great good*. Chess playing ought not to be a recreation only, but a useful study. Proficiency in the game is undoubtedly an indication of intellectual power. Professor Ruskin (in a letter to me a short time ago) said he should like to see Chess a class-subject in all schools. Without aspiring at present to quite as high a standard of usefulness, I am content to take lower ground, but only as a step to higher. A degree in Mathematical honours at Cambridge (Mathematics and Chess require like talents) is undoubtedly a great help to a man, either as a candidate for a post of duty or in

the duty itself, and I would plead that Chess should give like advantages, which would necessarily be more universal in their nature, for while a degree at the University is comparatively only within reach of the few, a high position in Chess may be obtained (after home study, club practice, &c.) by attending our Chess meetings. The meetings are annual, and continue a week, beginning on a Monday evening and terminating the following Saturday about noon. The local secretary gives full information as to lodgings, hotels, &c., to suit all purses, and the Congress, both in respect of time and money, is made as far as possible accessible to all.

The Hereford meeting was a particularly *class* representative one, not only by its patrons and supporters, but especially by its competitors, among whom were one of her Majesty's Inspectors of Schools, a master of an important National School, young men from Oxford and Cambridge, young clergymen and lawyers, clerks in offices, men in trade, &c., &c., ladies married and unmarried, along with many of the best living masters.

Taking very briefly another view, a Chess tournament tests very severely a person's patience, perseverance, temper, straightforward conduct, and general bearing towards others.

I arrive now at the *practical*. Let me venture to say that "The Counties' Chess Association" (an institution of twenty years' standing, and well recognised) would be glad to give certificates of attained proficiency after the ordeal of tournament, and such certificates could be countersigned by the president, say, of the club to which the person belongs, and to whom he would probably, in some way, be known in private life. Let such certificates, I would appeal to the general public, be considered as valuable additional recommendations. In Germany Chess helps a man to a useful life; may it do so, and in a higher degree, in England! The importance of the subject must be my apology for trespassing on your space.—I am, Sir, yours obediently,

A. B. Skipworth, Hon. Sec.,
Counties' Chess Association.

Tetford Rectory, Sept. 5, 1885.

Miscellanea.

A statement has just appeared in the *Cologne Gazette* of the cost of restoring and completing the great cathedral from 1823, when the work was resumed after a neglect of nearly three-quarters of a century, down to April 1 of the present year. The amount, including a contribution of 250,000 marks from the cathedral tax, was 21,000,000 marks, or £1,050,000. This is quite independent of gifts of valuable objects for the religious services or the decoration of the building, and of a large number of private donations and funds for pious foundations.

A bored tube well, 300 ft. deep, lined with extra strong wrought-iron tubes from the surface to the chalk, has recently been completed by Messrs. C. Isler & Co., on the premises of the Belfast and London Aërated Water Company, on Bankside. The chalk was reached at 204 ft. from the surface, after passing through 36 ft. of peat and gravel, 75 ft. of London blue clay, 93 ft. of mottled clays and light and brown sands with pebbles (Woolwich and Reading beds). Many objectionable springs were met, especially in the gravel bed overlying the London blue clay. These have been safely excluded from the well by means of the tubes, which are of even size, driven some distance into the chalk, preventing therefore any percolation from above. The supply is pumped direct from the chalk springs, at the rate of 72,000 gallons per day, whereas deeper wells, dug on the old principle, within a short distance, fail to yield sufficient quantities.

A new Transalpine line, the St. Bernard Railway, is likely to be commenced before very long, and to be, when completed, a dangerous competitor for the through traffic with the already existing route of St. Gothard. One of the principal features of the new project is that the indispensable tunnel under the Alps —at the Col Ferret—will be very much shorter than any other, either constructed or proposed to be constructed. The length will be only 9½ kilomètres (5¾ miles), while the Gothard tunnel is 15, (9¼ miles), the Mont Cenis 12, and those under the Simplon and Mont Blanc 20 and 19 kilomètres respectively. The total length of the St. Bernard line will be but 138 kilomètres, or 86 miles, making a saving between London and Brindisi over the St. Gothard route of 59½ miles.—*Engineer.*

Concerning glass-making, the *American Manufacturer* says:—"In the manufacture of glass fifty years ago 28 lb. of potash and 26 lb. of wood ashes were used to every 100 lb. of sand. The first change from this was to burn the potash in an oven, and work it as a puddler does iron, in order to obtain better results; and this was used with lime in about the same proportions as potash and wood ashes above named. Soda ash was first used in New Jersey, but its introduction in Western factories was very rapid, and the mix was changed to 33 lb. soda ash and 26 lb. of lime to 100 lb. of sand. The proportions vary greatly with circumstances and the quality of the ingredients used. The following is a fair statement of the mix now mostly used: Soda ash, 40 lb.; lime, 30 lb.; sand, 100 lb. For salt cake, 33 lb.; soda ash, 10 lb.; lime, 33 lb.; pulverised charcoal, 2½ lb.; arsenic, 1½ lb.; sand, 100 lb. If the glass is muddy, the charcoal is reduced; if too green, charcoal is added and arsenic reduced."

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March 1, 3, 5, Maidstone.

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